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INDEX TO CONTENTS, PAGE 320.

ADVERTISERS' INDEX, PAGE 24.

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THE AMERICAN GAS LIGHT JOURNAL INC.

VOL. CIII., No. 20. NEW YORK, NOVEMBER 15, 1915. WHOLE No. 2,130.

THE PRESENT PRACTICE OF GAS DISTRIBUTION BY BRITISH UNDERTAKINGS.

From paper by WALTER HOLE, to the International Gas Congress.

LOW PRESSURE.

Distributing Stations.—Taking a wide survey of the present practice of distribution of gas we are bound to recognize at the outset a very considerable change in respect to one of its larger aspects. The fields of supply of most of our cities and great towns have grown until they cover an enormous area. When only a low pressure supply was available, it became necessary to put down distributing and storage stations at convenient points, to cope with the demand at times of maximum output. But gas holders and all the et ceteras of a storage station are expensive, and it is all to the good from an economical standpoint, that the introduction of high pressure gas has made these largely unnecessary. It is, therefore, interesting to note that storage stations will soon be things of the past.

Districting.—Another of the larger aspects of distribution relates to districting. With the widely varying attitudes in many towns and cities, the varying needs of different districts in the town, and the heavier pressures at which gas is generally distributed to-day, as compared with a few years ago, some form of districting is necessary. This mainly takes two forms. Where the district admits, without a too great duplication of mains, districting by altitudes is naturally preferred. In cases where altitudes do not vary so greatly, the plan of districting by separate geographical areas commends itself. In this way districts which vary considerable in character may be governed separately. The industrial quarter, with its heavy day load, is thus treated according to its needs, without consideration of requirements of areas of different character. But whatever form is adopted the aim and object is one, namely, to enable the engineer to keep his finger on the pulse of the demand, and to give efficient supply according to the necessities of the moment in each separate case.

A third plan—which may or may not be properly classed as districting—that is being increasingly adopted, is that of the belt line main. As, however, such a main is generally used for high pressure gas, its purpose and usefulness will be discussed in the high pressure section of this paper.

In connection with "Districting" may be noted the interconnection of mains in the same area, known as the arterial system. Dead ends are an abomination to the distributing engineer. Whenever, therefore, it can be carried out without prejudicing larger considerations it is usual to link up the mains in the district supplied from the same governor. The advantage in case of naphthalene stoppages, or water logging of mains through subsidence, of repairs and new branch supplies involving cutting a main, and for the purpose of equalization of pressures, is obvious.

Pressures.—It is apparent that, however perfectly a system of districting may be devised, it is at best but a rough and ready method of meeting the needs of the case. The uses to which gas may be put in the same neighborhood are so varied and the individual needs so different. The demand may be intermittent and in any case is bound to fluctuate considerably over the district. The effect of friction in pipes is relatively greater to-day in comparison with the past owing to the greater velocities at which gas is distributed. Engineers are, therefore, turning to another solution of the problem. There appears to be no other plan of meeting all the complexities involved in maintaining a sufficiency of supply for all with an over-plus for none than that of carrying pressure in the mains sufficiently to meet the highest demands, and to govern down to others where necessary. The adoption of such a plan involves two serious consequences. Higher average pressure must be maintained throughout the district than has been considered expedient. Improved construction in connection with distributory systems will undoubtedly enable all the newer work to resist the increased tendency to leakage consequential on higher pressures. There remains only, therefore, the old mains to consider, and it is not difficult by progressive and systematic overhauling to put these into satisfactory condition. Probably, however, the fears as to largely increased leakage through working at higher pressures have not sufficient justification. A study of the *Gas World* "Analyses of Gas Undertakings," appears to show this. Speaking generally, gas is distributed at higher pressures to-day than say 10 years ago. In addition to raising pressures on the ordinary low pressure supply, it is probable that not less than one hundred and fifty undertakings also distribute high pressure gas, Yet a scrutiny of these analyses gives the following comparative results:

	Unaccounted-for gas—		Percentage on make—
	1905.	1909.	1913.
59 municipalities (average).....	6.6	5.9	5.7
42 companies (average).....	6.6	6.3	6.7
Average for 101 undertakings..	6.6	6.1	6.2

In other words, notwithstanding the greater pressures, and the vast increase of heavy roadway traffic, leakage has gone down by 0.4% during those years. There are some undertakings in this country distributing their low pressure gas supply at pressures up to and over 8″ water.

The second consequence is a considerable expenditure for service governors for controlling the supply to consumers where pressures are higher than necessary. This, however, is a comparatively small matter contrasted with the advantages the system affords.

Automatic Control of Governors.—Another line along which considerable pioneer work has been done is that of automatic distance control of pressures. The idea is to signal to the governor house at the works the pressures obtaining in the mains, the points chosen being those of worst supply. The simplest method of signalling is the ringing of an electric bell in the governor house when certain pressure is reached at the point selected. Next in importance is a continuous indication of the distance pressures on a dial, combined with the ringing of a bell when certain points are reached. A third method attempts the whole process by signalling the pressures, but automatically loading or unloading the station governors in accordance with the conditions. The latter idea is exceedingly attractive, and appears capable of wider application than it has received. Many hindrances have, however, been placed in the way of these devices in this country, owing to the difficulty of obtaining wayleaves for the necessary transmission wires.

Daytime Pressures.—Daytime consumption has now become so important that much higher pressures are maintained throughout the hours of daylight than formerly. Indeed many authorities now

make little difference between day and night, and it is generally conceded that modern domestic and industrial requirements demand not less than 20 tenths pressure at the point of combustion. Estimating, therefore, an absorption of 2 tenths pressure in the meter and a loss in the consumers fittings of 5 tenths, this necessitates a pressure of 27 tenths at all times upon the consumers premises, except perhaps for the few hours after midnight. In this connection may be noted the importance of continuous pressure charts taken at various central points in the area of supply, if the distribution is to be adequate and satisfactory.

The Distributory System Main Pipes.—The main pipes in general use for most purposes are of cast iron. While quality and chemical composition vary in different districts, the following is an average of that of three of the largest manufacturers:

	Per cent.
Iron	92.47
Combined carbon	0.37
Graphite	2.89
Manganese	0.67
Silicon	2.27
Sulphur	0.058
Phosphorus	1.26
Arsenic	0.00
	100.00

The dimensions and weights of pipes in common use are given in Appendix A.

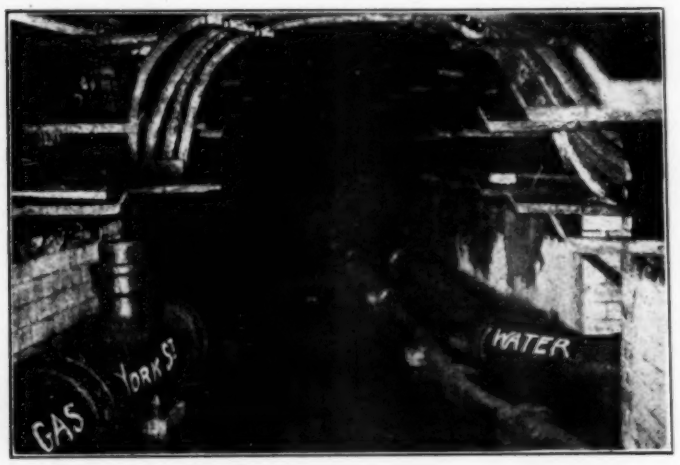

Fig. 1.—York Street Subway (Leeds) showing 14-inch gas main, 8-inch and 4-inch water main and electric cables.

Weakness of Cast Iron.—The durability and adaptability of cast iron pipes are beyond question. Their rigidity and liability to

Fig. 2.—York Street Subway, near Parish Church, showing 14-inch gas main, 12-inch lateral main at Duke Street.

fracture, however, place them at considerable disadvantage under modern conditions. One such condition is the tremendous increase of heavy and rapid vehicular traffic; the earth tremors thus caused being felt to a depth beyond that of pipes, and bound to have a prejudicial effect on any rigid system of canalization such as cast iron. Moreover, the improvement in construction of the modern roadway with its impermeable surface, renders even slight escapes of gas more difficult to trace and more dangerous in effect; it is increasingly inadvisable and inconvenient to disturb them when once laid.

Remedies.—A remedy is being sought along three different lines. The first, laying smaller distributing mains under footpaths. This removes them largely from the loading and vibratory strains incidental to the roadway, they are easily accessible, and the services, which are the chief source of leakage, are shortened considerably.

Subways.—The second is the provision of subways, in which pipes may be berthed. For a long time these were looked upon somewhat askance by gas engineers, but experience has proved their fears to be groundless. Unfortunately this remedy can only be applied in new districts or where large schemes of reconstruction are in progress, and their costliness hinders their general adoption. Figs. 1 and 2 show photographs of one of the subways in Leeds. Experience there has fully borne out the experience of other towns. The positive advantages of the system are very great, and have been previously pointed out by the writer as follows:

I.—The mains are kept dry, and are, therefore, correspondingly protected from corrosion.

II.—The mains are bare and get-at-able, and can, consequently, be further protected by painting.

III.—The mains are always open to inspection, and any fault can be immediately rectified without excavation.

IV.—The mains are relieved of the strains due to the weight of superincumbent earth.

V.—The mains are relieved of the strains due to subsidence of the subsoil.

VI.—The mains are relieved, to a large extent, of the strains due to vibration of the roadway.

VII.—The mains are free from the strains of suddenly applied loads due to heavy vehicular traffic.

VIII.—In consequence of the more equable temperature of a subway the joints are relieved of strains due to expansion and contraction.

IX.—There is less liability to attract wandering electric currents, and consequently less likelihood of electrolysis.

X.—The service pipes, which are the most perishable part of any distributing system, are much better protected, last longer, and, when necessary, are much more easily renewed.

XI.—The leakage account is, therefore, correspondingly reduced. Each line of pipe having its position, and being restricted to its own track, proper distances can always be maintained between mains and cables.

In addition to the usual precautions of valve provision for shutting off in case of emergency, and the use of the very best of materials and workmanship, two others that are not quite so obvious should be observed. They are:

XII.—If any danger of the subway becoming flooded, all mains that would be buoyant in water, should be securely bolted down upon their seatings or cradles. The writer has heard of mains floating out of position.

XIII.—Where mains pass immediately under manhole covers they should be bridged over with stout timbering. The writer had a large main splintered by the cast iron cover being dropped through on to the main.

Steel Mains.—The third remedy is pipes that, by their own resilience, will take up and neutralize the roadway vibrations. These qualities are found in steel pipes which have come so largely into use during the past few years. They cannot be broken either by crushing loads or the effects of roadway subsidence; they may be bent or distorted within certain limits without fracture; their tensile strength is approximately 25 tons per square inch, as compared with 7 tons per square inch in the case of cast iron. Manufactured in long lengths, the number of joints is greatly reduced and potential sources of leakage correspondingly lessened. Being smoother internally they have greater carrying capacity, size for size, than cast iron, and there can be no diffusion through the wall of the pipe. The dimensions of steel pipes commonly used in this country is given in Appendix B.

Durability.—It is far too soon to speak with any great degree of certainty of the durability of steel mains, inasmuch as their introduction is so recent. The writer's experience is altogether favorable. Some 3 or 4 months ago he had occasion to uncover a large steel main laid in 1899 in one af the city thoroughfares. Before being laid the pipe was thoroughly coated with Dr. Angus Smith's solution, but not wrapped. Upon being bared it was found in an excellent condition. In another portion of the city it

was recently necessary to remove a short length of 4″ steel main laid in October, 1908. This also was found to be in very good condition. Figs. 3 and 4 are photographs of this main, showing a

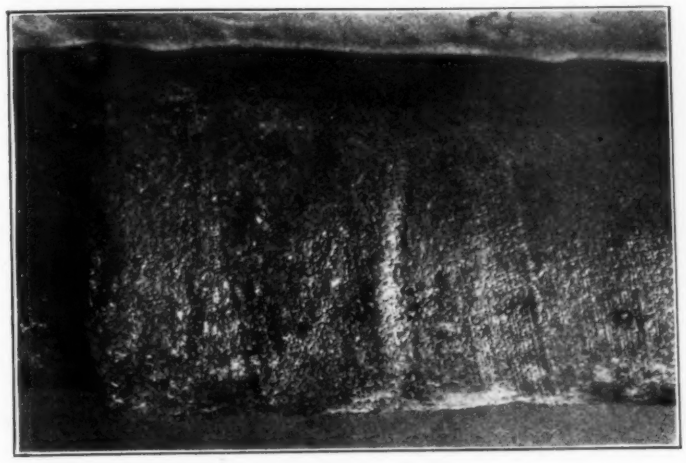

Fig. 3.—Piece of 4-inch steel tube wrapped with Hessian cloth photograped after having been buried 7 years.

piece just taken out of the ground, and after the jute wrapping had been removed.

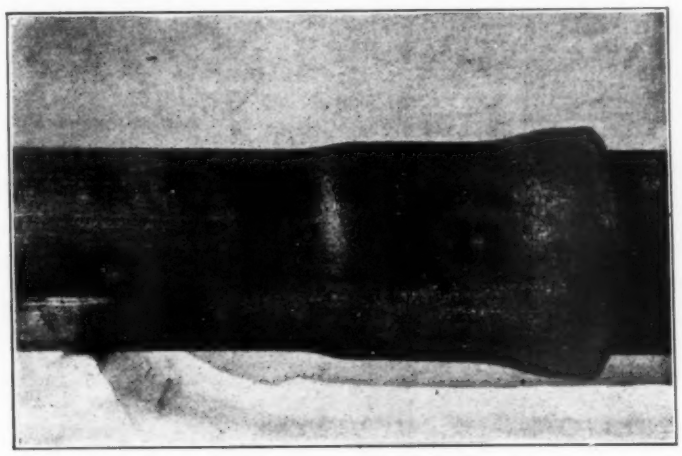

Fig. 4.—Same piece of pipe as in Fig. 3 but with coating removed.

Grades of Pipes.—Informed opinion is steadily tending to the substitution of rather heavier grades of pipes than used when steel pipes first came into general use. A few weeks ago the writer saw in a neighboring town 12″ steel pipes being used that were no less than ⅜ of an inch thick.

Open Lead Joints.—Both with cast iron and steel mains the open socketted lead joint is in common use. Many engineers still pin their faith to the run lead ring, while a large and increasing number adopt cold jointing with lead wool. The writer's experiments have convinced him that the lead wool joint is by far the stronger.

Density of Lead Wool and Run Lead Jointing Rings.—It is, however, a mistake to suppose that the strength is due to the greater density of the lead wool packing. On the contrary this is rather less dense than run lead. Four lead wool and run lead joints were made on a 6″ pipe, and a section of the joint cut out from front to back. The specific gravity of the whole section was found to be as follows:

Test.	Run lead.	Lead wool.
I.	11.329	11.150
II.	11.344	11.07
III.	11.12	10.95
IV.	11.220	11.086

After being tested as a whole, each section was tested for variation in specific gravity through the ring. In tests I, II and III the joint was cut into three sections; and in Test IV into five sections, from front to back.

The following very interesting results were obtained:

		Section.				
Test.		Face.	2.	Center.	4.	Back.
I.	Run lead	11.325		11.340		11.354
	Lead wool	10.971		10.093		11.202
II.	Run lead	11.337		11.351		11.344
	Lead wool	11.13		11.01		11.06
III.	Run lead	11.26		11.22		10.88
	Lead wool	10.90		11.32		10.63
IV.	Run lead	11.273	11.329	11.306		10.971
	Lead wool	11.111	11.049	11.061	11.090	11.120

It will be noted that in Test I the average of the subsidiary sections does not agree very closely with the specific gravity as a whole. This is particularly marked in the case of the lead wool ring, and is due to the section tested not being of the same size. The low result in the lead wool center may also possibly be due to a little tearing of the edges in cutting. In no case, however, were any of the rings appreciably denser at the face than either center or back, and in six cases was actually less. This is, of course, just what one would expect when the great pressure needed to compress a solid lead ring is taken into account.

Reasons of Greater Strength of Lead Wool Joints.—The greater strength of the lead wool joint is due to two factors. Firstly, the greater compactness of the yarn backing of the joint. In making a lead wool joint, the yarn is driven back by each successive ring of lead wool until it becomes quite compact and hard. In the run lead joint it is more loose and soft. In the one case the yarn alone will withstand a pressure of 100 pounds per square inch, while in the other it will not withstand half as much. In the second place, although the run lead ring may be denser in itself than the lead wool, it does not fill the socket so closely throughout its depth. The run lead is poured into the socket recess very hot. On cooling, it contracts and shrinks away from the interior surface of the socket. No amount of caulking will restore the ring throughout its full depth to a gas-tight contact with the two iron surfaces. Under a microscope the effect of caulking could be seen to extend to only ⅜ of an inch from the face of the joint. Compare with this the case of a lead wool packing; inserted and caulked up strand by strand, in closest possible contact from back to front and around the whole circumference of the joint, and it is bound to be the more gas-tight and stronger of the two.

Crystallization of Lead Ring.—Several interesting points in connection with a run lead joint are brought out in Fig. 5. The section taken was from one of the joints tested for specific gravity, and pickled in nitric acid to throw up the crystals. The section is exactly two inches long and the vertical lines divide the joint into four equal portions. In the portion at the back of the joint and up to the halfway line the crystals are quite normal. Then for ¾″ there is an area of disturbed crystals due possibly to the presence of vapors and to interrupted crystallization. For ⅜″ from the face of the joint the effect of caulking is more or less clearly marked. The cooling line running horizontally through the center of the lead ring is very noticeable for 1″ from the back, but becomes much less distinct towards the face, disappearing altogether as the face of the ring is reached. As previously suggested, shrinkage towards the center, which produces such a line, is one of the reasons for the essential inferiority of the run lead ring.

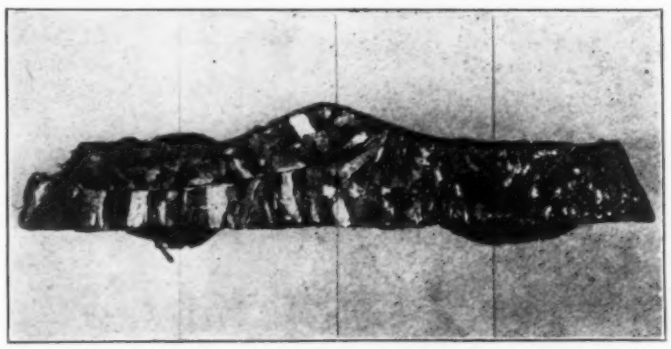

Fig. 5.—Enlarged Section through Run Lead Joint.

Pneumatic Caulking.—As far as the writer is aware, pneumatic caulking has not yet been introduced into this country.

Rigid Joints.—For steel mains additional strength is obtained by telescoping the spigot end, at a driving fit, into a special rolled out recess at the rear of the jointing space proper in the socket, and facing up with lead wool in the ordinary way. The extent of

the telescoping is generally equal to the diameter of the pipe. This relieves the jointing material of the greater part of the vibratory and other strains to which the pipe line may be subjected, and ensures a practically permanent sound joint. The "rigid" joint, as it is called, has quite superseded the ordinary type of open socket joint for steel mains, and in its turn appears likely to be eclipsed by the welded joint, shown in Fig. 6.

Fig. 6.—Welder at work.

Welded Joints.—In crowded thoroughfares, where the subsoil is already largely occupied by other services, or in places where it is inconvenient to have considerable stretches of trench open, the welded joint is not quite so easily applied as under other circumstances. The jointer needs much more room for welding than for making an ordinary lead joint, and this is not always easy to obtain. But even under the most adverse circumstances it is astonishing what may be done when there is sufficient determination. Last summer the writer laid over 1,000 yards of 10″ steel main with welded joints under the footpath of one of the busy thoroughfares of the city in a subsoil already fairly full of telegraph, telephone and electric cables, and low pressure gas mains. There were, of course, plenty of difficulties, but they were all successfully surmounted. In rural or suburban districts, however, the welded joint is almost perfect. It brings the ideal of a single continuous pipe from works to consumer, within the range of practical politics. Branches may be welded into the wall of the pipe in the exact position and at the precise angle required. The number of joints is reduced to a minimum. The smaller pipes may be bent to any curvature necessary as the work proceeds. Those of larger diameter may be gusseted to give bends of any degree and of any radius and made on the job to exactly fit local needs. One such is shown in Fig. 7. Where there is difficulty with joint holes, several lengths totaling to over 100 feet may be jointed above the trench and lowered into position together, thus reducing excavation and below ground jointing to a minimum. Where long lengths of trench may be kept open practically the whole of the jointing may be done above ground.

Fig. 7.—Gusseted Bend on 9-inch Steel Main.

Socket or Butt Welding.—The welded joint may be either the butt weld or telescopic socket weld. The relative tensile strengths of the two types were recently tested for the writer with the following results:

Test.	Cross section. Width in inches.	Cross section. Thickness in inches.	Area in square inches.	Reduction of area per cent.
Strip cut from pipe with butt weld	1.220	0.214	0.261	50.2
Butt welded joint	1.197	0.214	0.256	....
Strip cut from pipe with socket weld	1.191	0.226	0.269	53.9
Socket welded joint	1.161	0.212	0.246	....

Test.	Extension per cent on 4 inches.	Elastic limits in tons per square inch.	Maximum stress in tons per square inch.	Remarks.
Strip cut from pipe with butt weld,	30.5	14.5	24.12	Silky fracture
Butt welded joint	4.5	15.6	20.37	Fracture largely crystalline
Strip cut from pipe with socket weld	24.0	14.8	24.48	
Socket welded joint	....	....	8.68	

Further tests of other welded joints resulted as follows:

Test.	Cross Section. Width in inches	Cross Section. Thickness in inches.	Area in square inches.	Reduction of area per cent.
Strip cut from pipe with butt weld	1.102	0.211	0.232	50
Butt welded joint	1.177	0.219	0.258	..
Strip cut from pipe with socket weld	1.125	0.214	0.241	57
Socket welded joint	1.025	0.233	0.239	..

Test.	Extension of area on 4 inches.	Elastic limits in tons per square inch.	Maximum stress in tons per square inch.	Remarks.
Strip cut from pipe with butt weld	25.0	14.8	23.44	
Butt welded joint	11.7	14.1	23.12	Broke in weld
Strip cut from pipe with socket weld	27.7	14.7	25.18	
Socket welded joint	Practically none	9.11	9.11	Broke in weld

It is, however, only fair to point out that, tested in 1″ strips, the socket weld must always be rather prejudiced in comparison with the butt welded joint, inasmuch as in the former case the strain is not applied in a straight line passing through the center of the weld.

Loading Tests.—Tests were then made for resistance to loading strain. Two 9″ pipes were jointed by each method, and then supported on timbering 28 feet 6″ apart with the joint exactly in the center. They were then loaded at the center. The socket welded joint broke when weighted to 2 tons, 19 hundredweight, 1 quarter, 0 pound in 3 minutes, or at a breaking strain of approximately 15.3 tons per square inch; the butt welded joint was loaded to 3 tons. After standing for 10 minutes the load was increased to 3 tons, 1 hundredweight, 2 quarters, 17 pounds, representing a strain of about 17.6 tons per square inch, at which point fracture took place. Both joints went suddenly, without the slightest warning, but whereas the butt weld broke away entirely the socket weld, in spite of the fact that the strain was sufficient to open the longitudinal weld in the socket itself, still held around one-third of its circumference, being assisted very materially by the telescopic joint. Figs. 8 and 9 show enlarged photographs of the broken joints.

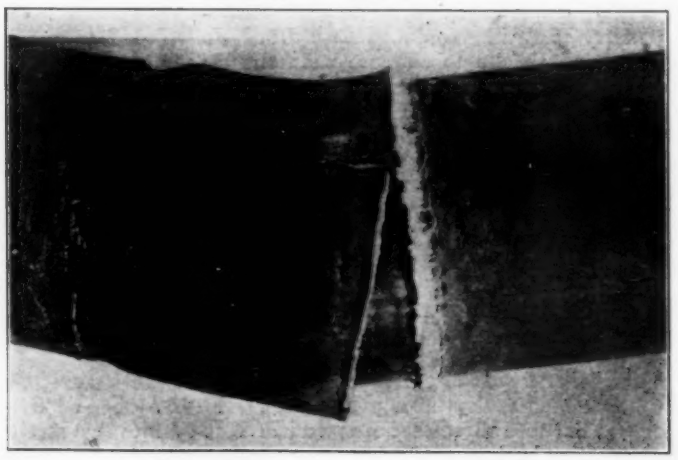

Fig. 8.—Enlarged photograph of socket welded pipe joint after breaking.

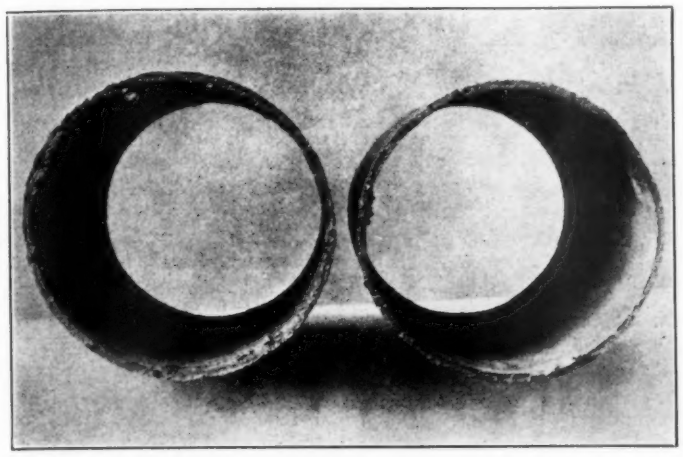

Fig. 9.—Enlarged photograph of broken butt welded joint.

Changes in Pipes due to Welding.—There can be no doubt that some small changes are brought about in the character of the metal where the weld is made. A little of the strength and elasticity are sacrificed, but that these changes are much less than is frequently alleged is shown by the character of the fractures in the above experiments. It is also proved by the following analyses from a paper read last year before the Institution of Mechanical Engineers:

Chemical Tests of Acetylene Welded Plates.

	Before Welding Per cent.	After Welding Per cent.
Silica	0.009	0.002
Carbon	0.150	trace
Sulphur	0.085	0.071
Phosphorus	0.068	0.067
Manganese	0.490	0.340
Iron (by difference)	99.198	99.520
	100.000	100.000

Costs.—The welded joint is rather more expensive to make than the lead wool joint, but the countervailing advantages are sufficent to warrant the increased expenditure. A good welder can make 14 to 16 9″ joints in a working day, with an expenditure of 4 pounds of carbide, 18 cubic feet of oxygen, and 1 pound of wire per joint.

Other Types of Joints.—Cement is frequently used with the ordinary open socket in certain districts, and under suitable conditions makes a very cheap and durable joint. On bridges, where considerable vibration has to be taken up, or in a yielding subsoil, or colliery districts, where extraordinary subsidences must be accommodated, the Foster joint, made with rubber rings, has been used with great success.

Services.—In general these are of wrought iron, and the economy of using only the heavier tubes is being increasingly recognized. Standard dimensions and weights are given in Appendix C. In all cases wrought pipe for service is given a good protective coating before using. Malleable fittings are being fairly extensively used, but for underground work the writer's experience is, that they are less satisfactory than ordinary wrought iron fittings. In some parts of the country the character of the subsoil renders the use of wrought iron services inadvisable. In these cases lead tubes are used, supported and protected by wooden troughs of either rectangular or "V" section, and connected to the mains by brass bend unions.

Public Lighting.—Raising of the Standard.—We are, just at present, living under an abnormal condition of things in this respect. But neglecting the exceptional circumstances of the moment, two developments in public lighting are most pronounced. The first and most obvious is the very considerable rise in the standard of public lighting, made possible by the introduction of large unit lamps of both high and low pressure type. In combination with and largely as a result of the comparative economy of these, has also come a closer spacing of the units. The natural result is that many of our principal thoroughfares are now brilliantly lighted. The standards adopted usually vary at ground level from a minimum of 0.007-foot candle in a back street, to a maximum of 2 or more foot candles in a main thoroughfare.

Automatic Control.—Clockwork Device.—The second development to which reference has been made, is in automatic control. This takes two principal forms, namely, clockwork and pressure wave. Of the former the best known types are the "Gunfire" and the "Hortsmann," and of these the largest installations are the 6,000 "Gunfire" at work in Liverpool, and over 2,000 each at Bournemouth and Dundee, and the 8,000 "Horstmann" controlers in Liverpool. In addition it would probably be no exaggeration to say that 250 towns have larger or smaller installations of one or other of these types, to say nothing of the other excellent clockwork devices on the market.

Pressure Wave Controllers.—The pressure wave controllers, of which the "A & M" and the "Broadberry" are the most conspicuous examples, are making considerable headway. The principal installation of the former is that of Newcastle-upon-Tyne, where there are already 7,000 at work, and the whole of the public lighting of the city is being gradually converted to control by this type. In 1911 the experience of a full year's work, with 250 of these controllers, was published. The failures were reported as 0.023% per actuation: a remarkably small number of failures quite confirmed in the writer's own experience. In a small preliminary installation of 91 controllers fixed on February 17th and running 103 days to date, the failures per actuation have been 0.32%. Of this number four lamps were responsible for no less than 32 failures. Other conditions were present for part of the time, which rather prejudiced the result and for which the apparatus was in no wise responsible. During the first 58 days the failures per actuation were 0.17%. The experiment is regarded so favorably that it has been decided to considerably extend the installation. The "A & M" is of the predetermined pressure type; the "Broadberry" controller, on the other hand, requires an increase of about 5-tenths pressure to operate it, which may commence from any level of presure obtaining at the moment. The principal installations of this type are in the North London districts of Islington, Stoke Newington, Tottenham, Edmonton, Southgate and Enfield, where over 8,000 are in use and giving every satisfaction.

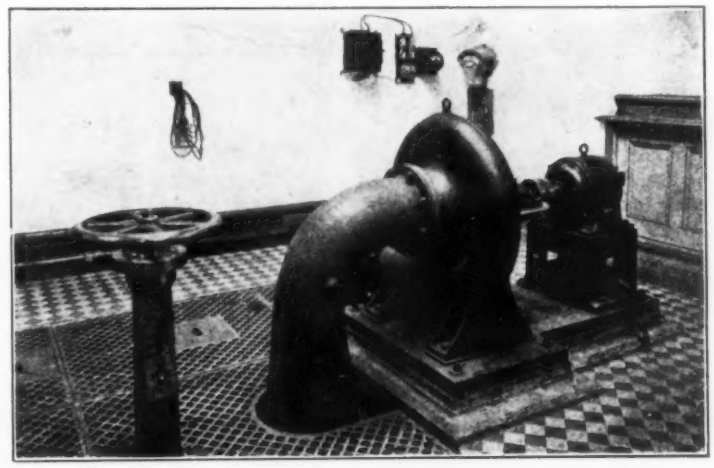

Fig. 10.—Motor Driven Rateau Fan at Dewsbury Road Gas Works, Leeds.

In adopting any pressure wave system it is of course necessary to provide against the possibility of stocks being low and consequent inability to give the necessary pressure wave by the holder alone. The auxiliary apparatus adopted in Leeds is shown in Fig. 10. It consists of a motor driven Rateau Fan which, at a speed of 1,430 revolutions per minute, is capable of raising 150,000 cubic feet of gas per hour against 3″ pressure with gas of 0.45 specific gravity. It is driven by a protected type induction motor with a short-circuited rotor designed to develop 4 brake horse power at about 1,430 revolutions per minute on a single phase 400-volt, 50-cycle circuit. The gas is governed on the outlet by a 14″ diaphragm non-return valve and a diaphragm pressure regulator.

(To be Continued.)

A New Aluminum Alloy.

A non-sweating and non-corrosive aluminum alloy recently patented (U.S. 1,146,185—July 13, 1915), consisting of aluminum, silver, copper and cadmium, is claimed to be peculiarly adapted to casting. The metals are combined in the proportion of 82 parts aluminum, one of silver, twelve of copper and five of cadmium, mixed in a special way. Tests of more than a year show it will withstand the action of spring or lake water without corrosion or stain, and that, while brass or bronze faucets and fixtures have been found to sweat under an internal pressure of 65 lb. per square inch, the new alloy has withstood 200 lb. pressure without such sweating.

THE HEAT TREATMENT OF IRON AND STEEL IN A NEUTRAL ATMOSPHERE.

Paper by ALFRED H. WHITE and HOMER T. HOOD to the Michigan Gas Association.

When iron or steel is heated to a high temperature, for forging or heat treatment, in a furnace where it comes into direct contact with flames, smoke, gases or other oxidizing atmosphere, its surface becomes first decarburized and then oxidized and covered with scale. Not only is the actual loss of metal in heating for the forge of considerable importance, but the surface decarburization is becoming of greater importance in view of the high standards demanded by the tool manufacturers and the automobile industry. It has shown that metal received from the rolling mill may show decarburization to a depth of 0.015 inch, and that the metal to that depth must be removed from the surface to eliminate all trace of decarburization. Decarburization due to heat treatment at lower temperatures is also evident, though not so serious. It is possible to avoid these undesirable changes by heating the metal in an externally fired muffle filled with an inert gas, such as nitrogen. Externally fired muffles, however, always show a low thermal efficiency, and there are difficulties in the production and utilization of nitrogen. Since heating in illuminating gas alone has been found to cause carburization of steel, while heating in the ordinary products of complete combustion causes oxidation, it seemed that somewhere between these two extremes there should be a composition practically neutral in its effect on steel. It seemed feasible to construct a muffle furnace with semi-direct firing, in which a mixture of gas with a small amount of air should burn within the muffle to form a neutral atmosphere, and subsequently burn with more air around the muffle and thus utilize the full thermal energy of the gas.

Whenever a number of substances are allowed to react with each other for a sufficiently long time they finally come to a definite stable condition called equilibrium. This equilibrium will vary with the temperature, pressure and concentration of the substances. A full solution of the problem here presented would call for a study of the equilibrium between the various possible compounds formed by the interaction of iron, carbon, hydrogen and oxygen. Such a complete solution, however, would demand a prohibitive amount of experimental work. For practical purposes it is not absolutely necessary that the atmosphere be strictly neutral, for the rate of reaction decreases as equilibrium is approached, so that there will not be serious change in the surface of the metal if the time of heating be short, even though there is a tendency towards a reaction in one direction or the other.

Although the equilibrium in the complicated system—iron, carbon, hydrogen, oxygen—has not been worked out, the simpler system—iron, carbon, oxygen—has been studied by several authors and is summarized by Arndt. From his figures it may be seen how great an influence is exerted by temperature. At 1100° F. iron will not be oxidized by a gas that carries 75 parts of CO_2 to 25 parts of CO, while at 1400° F. not more than 15 parts of CO_2 can be allowed to 85 of CO, if oxidation is to be avoided. The figures have not been worked out for higher temperatures, but it is evident that still smaller proportions of carbon dioxide, the oxidizing gas, must be maintained if oxidization is to be avoided at high temperatures. These considerations make it evident that it will be difficult to use producer gas for the production of a neutral atmosphere at high temperatures since its active constituent, CO, is almost necessarily associated with several per cent of CO_2 as it leaves the producer, and any attempt to produce a partial combustion in the presence of the steel would necessarily produce an oxidizing atmosphere.

Illuminating gas presents better possibilities than producer gas on account of the high percentage of hydrogen and hydrocarbons, which act as reducing agents. But in the flame from illuminating gas there will be present not only carbon dioxide as an oxidizing agent but also steam; and if oxidation of the metal is to be avoided the sum of these oxidizing gases must be kept low. A mixture of illuminating gas and air containing less than 80% of air, is no longer explosive and will not support combustion unless it receives heat from some external source. This condition is approximately realized in the ordinary Bunsen flame. Arndt in his summary of the work of various authors gives the average composition of the inner Bunsen flame to be:

Reducing Gases.		Oxidizing Gases.		Inert Gases.	
CO	2.2%	CO_2	7.2%	N	66.6%
H_2	2.8%	H_2O	20.2%		
CH_4	1.0%				
	6.0%		27.4%		66.6%

The oxidizing gases in the inner cone are therefore four and a half times as great as the reducing gases, and the mixture must exert a strongly oxidizing action on steels at high temperatures. If the amount of carbon dioxide and water vapor is to be kept low enough not to give an oxidizing flame, there will not be enough air in the mixture to support combustion under ordinary conditions. A part of the problem is therefore to design a furnace that will give high temperatures, and yet burn a very rich mixture of gas and air.

The Attainment of High Temperatures in a Neutral Atmosphere.—In ordinary complete combustion of gases the final products of combustion are CO_2 and H_2O. In the method here proposed the combustion within the muffle will be incomplete, and it is desirable to know what temperature it is possible to attain under such circumstances. To calculate the theoretical combustion temperature, it is necessary to calculate the volume of the several products of combustion and the amount of heat evolved in the combustion. The gas available was an unenriched coal gas with an average heating value of somewhat over 600 B. T. U., and it was found possible to burn this in the furnace described with two volumes of air. The calculations for volume of products of combustion and theoretical flame temperature are shown in Tables I. and II. The volume of the products of combustion is calculated in two ways, and check closely. The simplest method is to work from the percentages of nitrogen, and by this method the volume of combustion gases from one cubic foot of gas and two of air is calculated from Table I. as,

$$\frac{12.5 + 153.4}{52.6} = 3.16 \text{ cubic feet.}$$

The calculation based on the hydrogen contained in the incoming and outgoing gases is,

$$\frac{120.2 + 6.0}{39.7} = 3.18 \text{ cubic feet.}$$

The average of these, 3.17 cubic feet, is taken as the volume of the products of combustion of one cubic foot of gas with two of air. Applying this figure to the values for carbon in the gas as given in Table III. and multiplying the 18.7 volumes of carbon in the combustion gas by 3.17, 59.2 is obtained as corresponding to the carbon (calculated as gas) in 100 volumes of the inflowing gas. The actual figure for the inflowing gas is 60.6, which is 1.4 volumes greater than the amount found in the combustion gases. This corresponds to the free carbon which produced a slightly luminous flame within the retort.

TABLE I.—*Volume of Products of Combustion.*

Obtained from 1 cubic foot gas and 2 cubic feet air.

	Percentage composition of—		
Constituent.	Gas.	Air.	Products of combustion.
H_2O vapor	3.0	3.0	15.6
CO_2	1.8	....	2.5
Illum. (C_4H_6)	4.7	....	0.9
O_2	1.1	20.3	0.0
CO	6.9	....	9.8
CH_4	33.1	....	2.8
H_2	36.9	....	15.8
N_2	12.5	76.7	52.6
Total	100.0	100.0	100.0

Constituent	Total Vol. H_2 Entering into: 100 vols. gas.	200 vols. air.	100 vols. comb. gas.	Total Vol. N_2 Entering into: 100 vols. gas.	200 vols. air.	100 vols. comb. gas.	Total Vol. C Entering into: 100 vols. gas.	100 vols. comb. gas.
H_2O	3.0	6.0	15.6	....	.....	....	....	....
CO_2	....	...	....	....	.....	....	1.8	2.5
Illum. (C_4H_6)	14.1	...	2.7	....	.....	....	18.8	3.6
CO	....	...	....	....	.....	....	6.9	9.8
CH_4	66.2	...	5.6	....	.....	....	33.1	2.8
H_2	36.9	...	15.8	....	.....	....	....	....
N_2	....	...	....	12.5	153.4	52.6	....	....
Total	120.2	6.0	39.7	12.5	153.4	52.6	60.6	18.7

TABLE II.—*Theoretical Flame Temperature Obtained from 1 Vol. Gas and 2 Vols. Air.*

Net Heating Value of 1 Cubic Foot Illuminating Gas Burned Completely.

Constituents of Gas.	Net Heating Value B.T.U. per cu. ft.	Percentage in Gas.	Net Heating Value B.T.U.
Illuminants	2600.	4.7	122.0
CO	326.	6.9	22.5
H_2	275.	36.9	103.0
CH_4	900.	33.1	300.0
Net heating value per cubic foot (B. T. U.)			547.5

Net Heating Value of 3.17 Cubic Feet of Gases Produced by Burning 1 Vol. Gas and 2 Vols. Air.

Illuminants	2600.	0.9	23.4
CO	326.	9.8	32.0
H_2	275.	15.8	43.4
CH_4	900.	2.8	25.2
Net heating value per cubic foot (B. T. U.)			124.0

Net heating value from 3.17 cu. ft. (B. T. U.)	393.
Solid carbon in 3.17 cu. ft.=0.0005 lb	7.
(B. T. U.)	400.

	B. T. U.
Net heating value of gas on complete combustion	547.
Net heating value of products of incomplete combustion	400.
Heat liberated during incomplete combustion	147.

Maximum Theoretical Temperature of Products of Combustion.

Constituents	Vol. in cubic foot	Mean Sp. Ht. B.T.U. per cu. ft. Interval 60°-2,200° F.	Heat Absorbed for ° F. Rise in Temperature
H_2O	0.156	0.0245	0.0038
CO_2	0.025	0.0302	0.0007
CO-H_2-N_2	0.782	0.0189	0.0148
CH_4-Illum	0.037	0.0540	0.0020
(B. T. U.)			0.0213

Heat Absorbed by 3.17 cubic feet for rise in temperature of 1° F.= 3.17 × 0.0213 = 0.0675 B. T. U.

Heat available ..... 147.0 B. T. U.

Theoretical consumption temperature, above room temperature ..... $\frac{147}{0.0676}$ = 2,180° F.

Assume room temperature to be 70° F..... 70°

Theoretical combustion temperature..... 2,250° F.

The net heating value of the gas is used in these calculations for temperature, since the water formed will escape from the furnace in the form of steam. The specific heats used are the mean specific heats per cubic foot for the range up to 2,200° F. The theoretical combustion temperature that can be attained when one cubic foot of cold gas is burned with two cubic feet of cold air is 2,250° F., as is shown in Table II. Still higher temperatures would be theoretically possible if the gases of incomplete combustion could be completely burned in a secondary operation and made to give up their heat to the incoming air.

Experimental Work.—The laboratory furnace finally developed is shown in Fig. I. The heating chamber is a quartz tube, into whose lower end is luted a Meker burner with connections by which air and gas supply can be metered. The rich gas mixture is heated as it rises through the hot quartz tube and is ignited near the walls soon after reaching the hot zone. The heat of this initial combustion ignites the remainder of the gas so that by the time the mixture had risen half way in the tube, combustion is complete, and the upper half of the tube is entirely free from flame. The pieces of metal were heated in these hot gases of controlled composition. As the gases passed out of the quartz tube and turned to descend the annular space, more air was mixed with them, and the combustion completed as they passed down around the outside of the muffle. By this method the muffle was kept hot, and loss by radiation prevented, and the rich gas mixture brought up to kindling temperature by the radiant heat from the muffle; so that a mixture that would not burn in an open flame could be burned easily. Burning a mixture of two parts of air with one of gas, a temperature of 2,200° F. was easily maintained within the muffle.

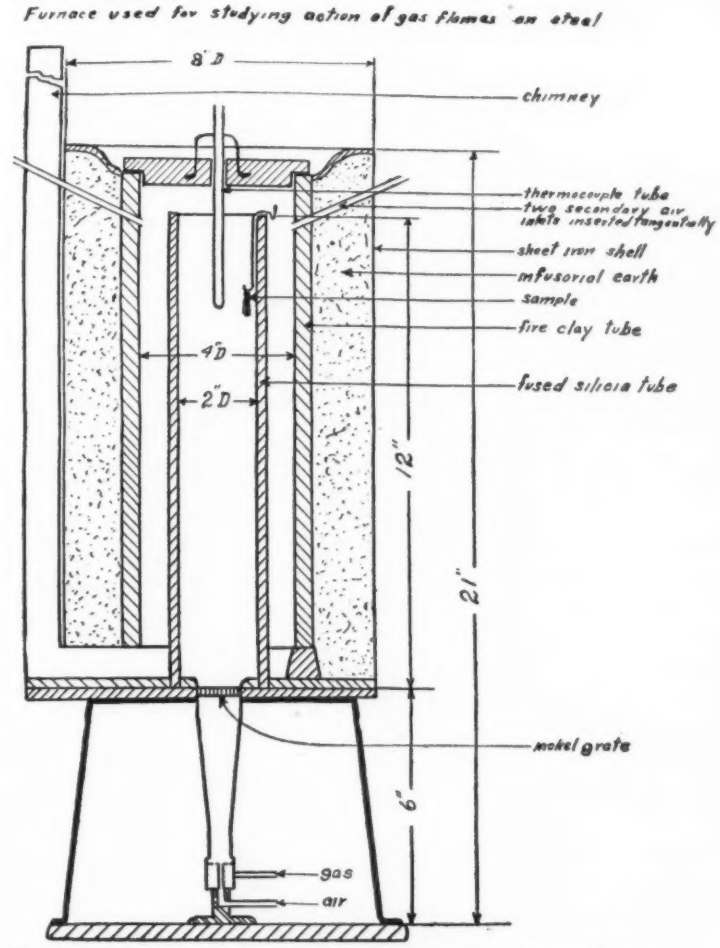

Fig. 1.—Laboratory Furnace for Heating Metals in Neutral Atmosphere.

The thermal efficiency of the furnace thus operated is indicated in Table IV., from which the following figures are taken:

Net heating value of gas on complete combustion, 547 B. T. U.
Net heating value of products of incomplete combustion, 400 B. T. U.
Heat liberated during incomplete combustion, 147 B. T. U.

Thus 147 out of the possible 547 heat units, or 27%, were liberated in the primary combustion around the metal, and the remaining 73% liberated in the secondary combustion around the muffle. No attempt was made to utilize the heat of the stack gases to preheat the primary air, but this might well be done in a large furnace. It would be possible in this way to burn richer mixtures of gas and air than was possible with the small furnace.

In order to sample the gas within the muffle, it was necessary to cool them very rapidly, so as to avoid change in composition. A capillary quartz sampling tube with its upper part water-jacketed was inserted through the hole in the cover, and in this way there was a temperature drop of about 1830° F. in one inch. From the capillary tube the gas was passed through a weighted calcium chloride drying tube to absorb the water vapor, and then into a two-litre gasometer from which samples were taken for analysis.

(*Continued on page 314*)

THE AMERICAN GAS LIGHT JOURNAL

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SANFORD K. CAMPBELL, Editor.

NEW YORK, MONDAY, NOVEMBER 15, 1915.

Evil Influence of Public Ownership.

Aside from the direct monetary losses to the taxpayers, and the injustice of taxing all for the benefit of those using the utilities, former Senator Jonathan Bourne, Jr., of Oregon, in an address in San Francisco, calls attention to the influence of Municipal Ownership upon the general activities of a community.

He said, in part:

"I am strongly opposed to public ownership, municipal or national, except where it is necessary to have government control in order to promote the public health, as in the case of water supply. My opposition is based not so much upon the question of relative cost of operation as upon the effect public ownership has upon the government itself, and upon the enterprise of its citizens.

"Comparatively speaking, it matters little if cost be increased and efficiency reduced. More expense and less convenience are ills of a superficial nature, and do not affect the larger interests of the people in a vital way. But the bad effect of public ownership upon the government itself, whether municipal, state or national, is of more than temporary concern and cannot be measured in dollars and cents. The evil effect of public ownership upon the creative constructive spirit of enterprise among the most active and capable of our people, constitutes a menace not only to the welfare of this generation, but to the progress of our people for all time.

"The desideratum of government should be the protection of its citizens, and only such restraint of individual action as is absolutely necessary to ensure the desired protection of all its citizens. As an incentive to individual enterprise and as a stimulant to individual initiative, the government should afford every citizen the largest opportunity for activity, with hope of commensurate reward consistant with the rights of others.

"Once established, public ownership will continue until its destruction is wrought. Once overthrown, individual enterprise will not be removed until public ownership has brought its ruin. Legislation can easily destroy but it cannot build up. The most it can do is give opportunity and incentive for individual activity.

"If any man believes that government ownership will solve the rate question, let him study the parcel post rates established by the postmaster general, under which the charge for a long haul is greater than the sum of the charges for two shorter hauls, equal to the longer distance.

"If he believes that discrimination will be avoided, let him study the facts in the blue tag order, under which the postmaster general ordered certain publications transported on freight trains, although paying exactly the same rates and therefore entitled to the same service, while competing publications of practically the same character and catering to the same trade, were transported on mail trains.

"An employer in private enterprise would come to look upon the government, not as an aid to him by the maintenance of equal opportunity, but as a rival, since the government would be competing against him in the employment market. Where the activities of the government are limited, as they now are, to practically operations necessary for the preservation of public peace, health and safety, rivalry in employment between public and private enterprise does not exist; but just to the extent that the government engages in undertakings that can as well be left to individual enterprise, it becomes a competitor with its citizens, and the destroyer of equal opportunity.

"Government ownership necessitates government regulation. Failure of government regulation means failure of government ownership. Success of government regulation eliminated the necessity or desirability of government ownership.

"Because public ownership increases the political power of the executive, tends to overthrow popular or truly representative government, and destroys individual initiative, I am opposed to it as a policy in either local or national government."

Public Utilities Section of the National Safety Council.

At the fourth annual safety congress of the National Safety Council, held in the Bellevue-Stratford Hotel, Philadelphia, the Public Utility Section was organized and the following officers elected: Chairman, H. C. Lucas, Philadelphia Electric Company; Vice-Chairman, Alonzo P. Ewing, Detroit City Gas Company; Secretary, G. H. Smith, Central Hudson Gas and Electric Company, Poughkeepsie, N. Y.

The sectional meeting devoted to public utilities was held and was presided over by Dr. E. B. Rosa of the Bureau of Standards, Washington. There were six 10-minute discussions on the following topics: "Linemen and their Hazards," by C. B. Scott, manager of the Bureau of Safety, Middle West Utilities Company, Chicago; "Danger of Low Tension Shocks," by H. S. Warren, American Telephone and Telegraph Company, New York; "Hazards of High Tension Lines," by B. E. Morrow, chief engineer Utilities Mutual Insurance Company, New York; "Hazards of Gas Works," by J. B. Douglas, manager claim department, United Gas Improvement Company, Philadelphia; "Hazards of Street Work," by E. C. Spring, assistant to the president of the Lehigh Valley Transit Company, Allentown, Pa.; and "Education of Street Car Platform Men," by F. J. Warnock, claim agent, Mahoning & Shenango Railway and Light Company, Youngstown, O.

Illuminating Engineering Society.—American Electro-Chemical Society.—Joint Meeting.

Electrical phenomena in vapors and gases was the subject covered at the joint meeting of the above societies on Thursday evening, Nov. 11, at the Engineering Societies Building, New York City.

Prof. W. G. Cady went into the theory, Mr. D. M. Moore showed a new portable type carbon dioxide tube suitable for color matching, and Mr. W. A. Darrah demonstrated an entirely new form of arc consisting of a bulb in vacuum with terminals of tungsten placed about 4 inches apart. The bulb is supplied with Titanium Tetra-Chloride and Bromine. While only in the experimental stage the long arc of 4 inches and the blue white color gives promise of valuable development. There was one gas man present.

[Official Notice.]

New Jersey State Gas Association.

Office of the Secretary,
759 Broad Street, Newark, N. J.

Regular fall meeting of the New Jersey State Gas Association will be held on Tuesday, Nov. 23d, at noon, Klein's Hotel, New Brunswick, N. J. The meeting will open with a luncheon, after which there will be inspection of plants, using gas for industrial purposes. The regular session will begin at 2 P.M., when there will be a paper on "Industrial Fuel Appliances," by Mr. F. A. Tuttle, and another on "Window and Office Display," by S. H. Alexander. Members are especially requested to bring their friends to this meeting.

O. F. Potter, Secretary.

ELEVENTH ANNUAL CONVENTION AND GAS APPLIANCE EXHIBIT, NATIONAL COMMERCIAL GAS ASSOCIATION, WASHINGTON, D. C., NOV. 29 TO DEC. 4, 1915.

Members of the National Commercial Gas Association are invited and urged to attend the forthcoming Eleventh Annual Convention and Exhibition of Gas Appliances, at the New Willard Hotel, Washington, D. C., November 29th to December 4th. The meeting will be a fitting end to one of the most successful years in the Association's history. A large attendance is assured, and the meeting and exhibit should be helpful to every member. All of the sessions will be held in the New Willard Hotel, in a large hall immediately adjoining the ball room, in which latter will be the appliance exhibits.

The opening session of the convention will be Tuesday morning, November 30, at 10 o'clock.

In order to allow the delegates full opportunity for study and comparison of the various appliances on display, as well as to give the manufacturers' representatives opportunity of attending the sessions, there will be no morning sessions, except the opening session, on Tuesday morning, and a special session on Thursday morning for the Industrial Fuel and the Differential Rates Committee. Members who are interested in these topics are invited to attend these committee sessions.

The Registration Bureau will be located in the hall immediately adjoining the Convention and Exhibition Halls, and will be open Saturday morning, November 27th, and every day during the convention. All members, whether registered in advance or not, are requested to register immediately upon arrival, and those who expect to attend are requested to notify the Association, at its offices in New York city, as promptly as possible. This will greatly facilitate the work of the Registration Bureau.

Members desiring advance copies of papers can secure them by applying to the New York Headquarters of the Association, 61 Broadway, New York city.

Hotels and Headquarters.—Hotel reservations must be made by members direct with the hotels. The New Williard Hotel will be the headquarters of the Association. The following hotel rates will be in effect:

The New Willard—Single rooms, without bath, $2.50 and $3 per day; with bath, $3.50 and $4.

The Raleigh—Room, without bath (1 person), $2.00 and $2.50 per day; with bath, $3.00 per day upward.

The New Ebbitt—American Plan—Single room, without bath, $3.50 per day; with bath, $4.50 per day. European Plan—Single room, without bath, $1 50 per day; with bath, $2.50 per day.

Entertainment Features. The Entertainment Committee has prepared a program that will not interfere with the business of the Convention. There will be many interesting and entertaining functions during Convention Week, but the Association is on record as discouraging any tendency to consider its annual gatherings as anything but business meetings, with, of course, the proper relaxation and diversion in the right place.

PAPER PROGRAM (Subject to Revision).

Tuesday Morning, 10 O'clock.

Address of welcome and response.
Report of Board of Directors.
Report of Treasurer.
Report of Finance Committee.
Report of Committee on Amendments to Constitution.
Report of Committee on Public Policy.
Report of Committee on Membership.
Report of Committee on Company or Local Sections.
Report of Manufacturers' Section.
Address of the President.
Report of Nominating Committee.
Report of Time and Place Committee.

Tuesday Afternoon, 2 O'clock.

Paper: "Selling Gas Service," by George Williams, of H. L. Doherty & Co., New York, N. Y.
Paper: "The Principles of Merchandising as Applied to Gas Service," by Joseph H. Appel, Director of Publicity of the John Wanamaker Stores.
Report of Publicity Committee.
Report of Advisory Committee to the President.
Report of Committee on Standardization of Gas Appliance Specifications.
Report of Advisory Committee on Exhibitions.

Wednesday Morning.

No open session. Open for members to visit exhibit.
Special session of Differential Rates Committee.

Wednesday Afternoon, 2 O'clock.

Report of Committee on Reciprocal Relations with other Associations.
Report of Illumination Committee.
Paper: "Some Notes on the Maintenance of Incandescent Gas Lighting," by L. B. Eichengreen, The United Gas Improvement Co., Philadelphia, Pa. (I. E. S.)
Paper: "Fundamental Principles of Good Lighting," by Dr. P. G. Nutting, Eastman Kodak Co., Rochester, N. Y. (I. E. S.)

Thursday Morning.

No regular session. Open for members to visit exhibit.
Special session of Committee on Development of Industrial Fuel.

Thursday Afternoon, 2 O'clock.

Inspirational address, by Hon. James M. Beck.
Report of Board of Educational Control.
Report of Committee on Salesman's Handbook.
Report of Accounting Committee.
Report of International Committee on Commercial Advancement.
Report of Committee on Domestic Fuel Appliances.

Friday Morning.

No regular session. Open for members to visit exhibit.

Friday Afternoon, 2 O'clock.

Report of Committee on Development of Industrial Fuel.
Report of Committee on Central Development Bureau.
Report of Commitee on Heating, Refrigerating and Ventilation.
Repord and Recommendations of Committee on Differential Rates.
Closing of Convention.

Transportation Arrangements.—The Transportation Committee has arranged special train and car service, and as only a limited number of cars will be carried, it is essential that the railroads be notified well in advance. It is important, therefore, that those desiring accommodations notify the member of the committee having charge of the particular train or car on which reservation is desired.

"St. Louis Special"—From St. Louis, via Vandalia R. R. and Penna. lines.

Sunday, November 28.

Lv. St. Louis, Vandalia R. R., Train 26 (Central Time) .. 12:08 P.M.
Lv. Terre Haute ..... 4:50 P.M.
Lv. Indianapolis, Penna. Lines ..... 6:45 P.M.

Monday, November 29.

Lv. Columbus, O. ..... 12:35 A.M.
Ar. Pittsburgh ..... 5:42 A.M.

To be attached to P. R. R. Special Train at Pittsburgh.

Post cards requesting reservation in these cars, including reservation on the Pittsburg-Washington Special Train, should be addressed to C. C. Curtice, District Passenger Agent, Vandalia Railroad, 10th and Olive streets, St. Louis.

"Boston Special"—From Boston, via N. Y. N. H. & H. (South Station or Back Bay) and Fall River Line.

Sunday, November 28.

Lv. Boston (South Station) ..... 6:00 P.M.
Ar. New York ..... 7:00 A.M.

Post cards requesting reservation on Fall River Line, including reservation on the New York-Washington Special Train should be addressed to R. C. Ware, Boston Consolidated Gas Co., 24 West street, Boston.

"Chicago Special"—From Chicago, via Pennsylvania Lines.

Sunday, November 28.

Lv. Chicago, Train 2 (Central Time) ..... 5:30 P.M.

Monday, November 29.

Ar. Pittsburgh ..... 5:30 A.M.

To be attached to P. R. R. Special Train at Pittsburgh.

Post cards requesting reservation to these special sleepers, including reservation on the Pittsburgh-Washington Special Train, should be addressed to O. T. Knight, Peoples Gas Light and Coke Co., Chicago.

"Detroit and Toledo Special."—From Detroit and Toledo, via Michigan Central and Pennsylvania Lines.

Sunday, November 28.

Lv. Detroit, Mich. Centtral (Central Time) ..... 8:20 P.M.
Lv. Toledo, Pennsylvania Lines.. ..... 10:35 P.M.

Monday, November 29.

Ar. Pittsburgh ..... 5:50 A.M.

To be attached to P. R. R. Special Train at Pittsburgh.

Post cards requesting reservation in these special sleepers including reservation on the Pittsburgh-Washington Special Train, should be addressed to R. C. Fowler, Detroit City Gas Co., Detroit.

(*Continued from page 311.*)

The Heat Treatment of Iron and Steel in a Neutral Atmosphere.

Since rapidity of oxidation is a function of the extent of surface of the metal, and it was desired to get as positive results as possible, the metal tested was in the form of very fine wire. A piece of No. 34 soft iron wire (0.005″ diameter) about 10 feet long, was wound into a small spiral and weighed. It was then hung on a hook of heavy wire and suspended in the upper part of the central tube of the furnace, in the gases that had come to equilibrium in the lower part of the tube. The coil of wire was usually left in the furnace for an hour—an excessively severe test. Special precautions had to be taken in removing the hot wire from the furnace, as, if removed while hot. it would be badly oxidized in the few seconds' exposure to the air. In order to cool it before taking out, a small piece of gas pipe with one end closed was lowered into the furnace and the sample placed inside. Here it was cooled by radiation to the cold walls of the pipe, and the pipe was removed before it had time to get hot. It is probable that even this method allowed slight oxidation, as a little air would be left in the pipe. After removing, the sample was weighed and a calorimetric determination for carbon made. The increase in weight represented the amount of oxygen absorbed to form magnetic oxide (Fe_3O_4). This oxide contains 2.61 parts of iron for each part of oxygen, so that an increase in weight of 1% means that 2.6% of iron oxidized. This wire was very nearly 0.005″ in diameter and a pound of it had a surface of about 20 square feet, If 25% of it was oxidized the depth of penetration of the oxidation would be only 0.00035″ and a 2% increase in weight, equivalent to 5.22% oxidation would mean a depth of oxidation of only 0.00005″. So it is seen that a very slight thickness of oxide is easily measured. Since this wire contained initially only 0.04% of carbon, an analysis of the treated wire did not show the decarburization very accurately, so further tests were made on steel piano wire. The smallest size of this wire at hand was No. 28, 0.014″ in diameter; and the calorimetric test showed about 1.25% of carbon before heating, but practically no carbon after heating for an hour at temperature of 2100–2200° F. Under these circumstances a 1% gain in weight meant a 2% gain in oxygen since the wire lost about 1% of carbon during the heating process. This 2% increase in oxygen meant 5.2% oxidation, and corresponded to a depth of oxidation of 0.00175″. If the piece did not change in weight, but 1% of the carbon was lost and replaced by 1% of oxygen, then the depth oxidation would be 0.0008″.

Effect of Heating Mild Steel in a Neutral Atmosphere.—Data of tests on the iron wire with 0.04% carbon given in Tables III. and IV. It will be noted that the tests are excessively severe, the fine wire being directly exposed to the gases at 2100–2200° F. for from 35 minutes to 2 hours. The figures in Table III. are arranged according to the volumes of air used. With 2.5 volumes of air to one of gas the fine wire is, after an hour's heating, converted almost completely into oxide, and with 2.4 volumes of air the oxidation shown by the increase in weight amounts to 56%. (Exp. 10). However, with this fine wire, even this high oxidation gives a film of oxide only 0.0008″ in thickness, a thickness negligible in ordinary work, The composition of the gases surrounding the wire while being heated is shown in Table IV. The oxidizing agents (carbon dioxide, steam and a trace of oxygen) amount in Test 10 to 18.3%, and the reducing agents, consisting of (carbon monoxide and hydrogen with a small percentage of methane), amount to 27.8%. The ratio of the reducing gases to the oxidizing gases is 1.52.

TABLE IV.—*Gas Analyses.*

Test No.	Average for illuminating gas used.	Composition of gases after partial combustion. 5	6	7	10	12
H_2O (vapor)	3.1	14.6	15.6	14.7	15.6	13.9
CO_2	1.8	3.2	2.5	2.8	2.6	2.0
Illuminants	4.7	.0	1.0	.6	.0	.9
O_2	1.0	.0	.0	.2	.2	.2
CO	6.9	12.3	10.8	12.7	13.1	10.6
CH_4	31.1	.9	2.4	1.2	2.8	2.9
H_2	36.9	12.5	17.6	19.4	12.9	17.5
N_2	12.5	56.5	50.1	48.4	52.9	52.0
Temperature °F		2100	2135	2170	2080	2100
Ratio $\frac{\text{Air}}{\text{Gas}}$		2.25	1.98	1.90	2.40	1.86
Sum oxidizing agents CO_2, H_2O, O_2		17.8	18.1	17.7	18.3	16.1
Sum reducing agents, H_2, CO, illuminants, CH_4		25.7	31.8	33.9	27.8	31.9
Ratio $\frac{\text{Reducing agents}}{\text{Oxidizing agents}}$		1.45	1.76	1.91	1.52	1.98

With slightly richer gas mixtures the oxidation, even as shown by the sensitive test of increase in weight, becomes very small. With less than two volumes of air the flame in the inner muffle became distinctly yellow, seemingly a good indication that oxidizing conditions had disappeared, for the samples (Nos. 6, 9 and 12), heated under these conditions, showed almost no increase in weight and no brittleness on bending, and retained their silvery metallic lustre. Analysis of the gases from the muffle showed the ratio of reducing to oxidizing gases to be from 1.76 to 1.98. It was stated in the earlier part of this paper that the work on carbon monoxide had shown that in order to prevent oxidation of iron it was necessary to have more than five times as much CO as CO_2 present. With products from the incomplete combustion of illuminating gas that contain small amounts of hydrocarbons and material amounts of hydrogen, conditions seem much more favorable.

Effect of Heating High Carbon Steel in Neutral Atmosphere.—The steel wire used in these tests contained 1.25% carbon and was 0.014″ in diameter. When heated to 2,000–2,200° F. for one hour, under conditions similar to those used for the soft iron wire, it was found that oxidation of the metal could be prevented, as with the soft iron wire, but that decarburization could not be prevented. In every experiment at these high temperatures, practically all of the carbon was removed from the metal. This would mean that the decarburization, after one hour at this temperature, had progressed at least 0.007″ from the surface. This is not altogether unexpected, since hydrogen as well as carbon dioxide and steam acts as a decarburizing agent. The rate of decarburizing would certainly be slower in this gas than in ordinary furnace operation, and by the use of still smaller amounts of air decarburization might be altogether prevented, since case-hardening may be produced

TABLE III.—*Extent of Oxidation of Fine Iron and Steel Wires When Heated to 2200° F. in Nearly Neutral Atmosphere.*

A—Tests with Iron Wire 0.005 inches Diameter and containing 0.04% Carbon.

Test No.	Weight of wire in grams. Before.	After.	Per cent. increase in weight.	Calc. per ct. of Fe changed to FeO_3.	Calc. Depth of scale in inches.	Ratio Air-Gas.	Mean temp. ° F.	Time of heating.	Color of flame at top of muffle
3	0.3075	0.4200	36.5	95.5	0.002	2.5	2228	1 hr.	Colorless flame
4	0.3060	0.3645	19.1	50.0	0.00073	2.43	2100	25 mim.	" "
10	0.3010	0.3655	21.4	56.0	0.00084	2.40	3080	1 hr.	" "
5	0.3050	0.3520	15.4	40.3	0.00057	2.25	2100	1 hr.	" "
11	0.2995	0.3350	11.8	30.9	0.00043	2.20	2090	1 hr. 15 min.	Slightly colored
8	0.3060	0.3320	8.5	22.3	0.00029	2.16	2170	2 hrs	" "
7	0.3045	0.3105	2.0	5.23	0.00005	2.08	2170	2 hrs.	" "
6	0.3175	0.3185	0.3	0.78	0.00001	1.98	2135	45 min.	Yellow flame
9	0.3146	0.3073	1.2	3.14	0.00004	1.87	2220	1 hr	" "
12	0.2997	0.3007	0.3	0.78	0.00001	1.86	2100	1 hr.	" "

B—Tests with Steel Wire 0.014 inch Diameter and containing 1.25% Carbon.

14	0.2935	0.3017	2.79	10.60	0.00038	2.40	2080	1 hr.	Colorless flame
15	0.2995	0.3035	1.33	6.76	0.00029	2.20	2090	1 hr.	Slightly colored
13	0.3745	0.3743	0.0	3.28	0.00012	1.87	2220	1 hr.	Yellow flame
16	0.3073	0.3065	—0.26	2.60	0.0001	1.86	2100	1 hr.	" "

when pure illuminating gas is used. There should be no difficulty in preventing decarburization at the temperatures used in heat treatment of steel. The details of the tests on steel wire are given in Part B of Table III.

SUMMARY.

It has been shown that it is entirely possible to heat iron and steel in an internally fired muffle, even to forging temperature, without any oxidation or formation of scale on the surface of the metal. A neutral atmosphere is produced when approximately one volume of illuminating gas is combined with two volumes of air; a mixture so rich that it will not burn unless preheated. This atmosphere, although neutral to iron, decarburizes steel slowly at forging temperatures; but it is a much less active decarburizing agent at this temperature than the ordinary furnace atmosphere, and may be rendered still less active by using a mixture richer in gas. At the temperatures used in heat treatment, gas of this composition would not have a cecarburizing action.

It should be feasible to make a commercial application of this process. The heat evolved by the primary combustion within the muffle is about 27% of the possible total heat, and is sufficient to give a theoretical combustion temperature of 2,200° F., starting with cold gas and cold air. A secondary combustion around the muffle aids in keeping up the temperature so that there is no trouble in actually realizing 2,200° in a muffle. This secondary combustion liberates all the heat units in the gas, and so raises the thermal efficiency. If the sensible heat of the waste gases was used to preheat the entering air, a high efficiency could be obtained. When starting with a cold furnace, the full amount of air for complete combustion could be introduced within the empty muffle, which could thus be quickly brought to working temperature. The primary air supply could then be reduced to the desired quantity, and the metal introduced into the muffle, where, exposed to the neutral gases, it would be more rapidly heated than in an externally heated muffle, and would be protected from oxidation. The saving in metal should be considerable, and would probably compensate for any increase in the cost of fuel. The process presents attractive possibilities in its application to the automobile industry and other industries where quality is paramount.

Gas Analysis by Low Temperature Fracturization.

Technical paper 104 of the Bureau of Mines, "Analysis of Natural Gas and Illuminating Gas by Fractional Distillation at Low Temperatures and Pressures," is by G. A. Burrell, F. M. Seibert and I. W. Robertson.

This publication, one of a series dealing with increase of efficiency in the production and utilization of fuels, describes in detail the results of the Bureau of Mines experiments with a method of separating and determining the hydrocarbons in gaseous fuels by fractional distillation in a vacuum at low temperatures. The gas is liquefied, the different constituents separated by proper adjustment of temperatures, the various fractions removed with a mercury pump, and analyzed by ordinary slow-combustion methods. The method was successfully applied to separation of the hydrocarbons in natural gas and in artificial gas, and is the only known method applicable to the separation of some hydrocarbons.

The first part of the report describes the experiments by which the natural gas used in Pittsburgh, Pa., was separated into its individual paraffin hydrocarbons; the second part, experiments in which the separation of the illuminants in the artificial gas used in Pittsburgh, Pa., and that used in New York city were effected. Other experiments were made to determine the practicability of separating gases whose boiling points lie close together, such as ethane and ethylene.

Much experimental work in the destructive distillation of liquid, gaseous and solid fuels yields complex mixtures of different hydrocarbon gases. In reports on the tests some of the gases are not separated, but are lumped together as illuminants (determined by absorption in fuming sulphuric acid or bromine water), or calculated in the combustion analysis as methane and ethane. By the methods described in this publication the individual gases can be separated. Hence a wide field of investigation is opened up, in that a much more exact study of combustion processes can be made and chemical changes more closely followed and better understood.

Copies of the paper may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

A Motor-Driven High-Pressure Gas Pumping Installation.

Paper by J. S. HAUG, to the Canadian Gas Association.

The increase of gas consumption in cities with many paved streets, and with outlying districts to be served, has brought to most of us the problem of high pressure distribution. Nowadays it is not the question whether we shall include booster or gas pumps in our plant. That has already been decided for us. Most of us must send out part or all of our gas by high pressure distribution, and the only question to decide is—What kind of apparatus to adopt?

The type of gas pump or booster is determined to a great extent by the distribution pressure it is necessary to carry. The centrifugal fan is found attractive for pressures up to approximately one pound, by reason of its simplicity and low first cost. Its high rotative speed makes it suitable for direct connection to an electric motor or a steam turbine. The minimum number of bearings to oil and take care of, and absence of gearing, makes the maintenance charges low. Its efficiency is not very great, however, and power costs are comparatively high. For light work, however, this is not such an important factor. When the pressure to be carried rises above one pound the efficiency falls still more rapidly, and high power costs make it impractical to utilize this type of booster.

The positive rotary blower or gas-exhauster is very largely used for pressures ranging from 1 to 10 pounds. Heavier work demands a heavier machine, and massiveness is a characteristic of the positive blower. This, combined with the accurate machining necessary, runs up the first cost, but the absence of small wearing parts to break and get out of order, makes for low maintanance charges. The mechanical and volumetric efficiencies are high, the latter being about 80 to 90%, if properly constructed and finished. There are six bearings on the horizontal single geared exhauster when arranged for steam drive, and nine when arranged for herringbone gear reduction for connection to electric motor. The bearings, are, however, constructed with large surfaces and quarter box adjustment, and are ring oiling. The actual care and attention necessary is consequently a minimum, and if kept in proper adjustment there seems no reason why such a machine should not give 20 years' service, with but a normal charge for repairs. As we approach 20 pounds pressure the heating of the casing of the positive exhauster becomes noticeable, and as the impellers are naturally at a still higher temperatue, it becomes necessary for higher pressure, to have them water-cooled. This introduces undesirable complications and consequently the most practical machines is the reciprocating compressor.

The gas compressor, which is practically the same machine as the air compressor, is satisfactory for all pressures above 10 pounds per square inch. This machine, while highly efficient, is more complicated and consequently expensive. As a matter of fact very few distributing systems find it necessary to employ such high pressures, since power charges soon become excessive.

In addition to the machines described there is the turbine fan or turbine compressor, which is suitable for all pressures and may be described as the centrifugal fan made highly efficient by careful design and construction. This, however, is as yet very expensive on account of its limited development. In making a survey of the whole problem we obtained prices on machines of this type, among others, and found that we could install one whole plant, including foundations, pipe connections, building and electric service for less than the turbo-compressor units alone would have cost us.

Since our distribution pressure was fixed at about 6 pounds, the natural choice was the positive rotary exhauster, which we may say has justified our choice by its general satisfactory operation. The next point for decision was the prime mover or source of power, and the choice of steam or electricity was open to us. The first choice of every gas man is the steam engine, for absolute dependability, safety and flexibility. It is particularly adapted for driving gas boosters, since by means of a pressure governor the pressure on the mains can be maintained automatically at any point desired. The absence of sparks is a condition to be desired in a booster room almost as much as in a powder works, and the danger of an interruption in service is very remote. To adopt the steam engine drive, meant, however, spending 50% more money in foundations, 50% more in building, and half as much as the whole boosting plant was worth in added capacity of steam lines. In addition to this, there was the prospect of being obliged to put on another boiler before starting our larger machine, which takes 270-horse power, and then letting the boiler down after stopping.

Most important of all, we found that it was far cheaper to operate an electrically driven machine at full load than to operate the steam driven machine at a variable load, taking standby losses into consideration. This was, of course, due in a great degree to our favorable situation as regards electric power. In brief we found that the adoption of the steam drive would saddle us with a very heavy overhead charge, and in addition a heavy operating charge, and this decided the adoption of the electric drive.

In selecting the motor we decided upon the variable speed induction motor with wound rotor and collector rings. The speed variation is accomplished by inserting resistance, in the form of cast iron grids, in the rotor circuit, thus reducing the speed to any desired point. The speed is governed by a controller very much the same in general appearance as the street car controller, but somewhat larger. Our electrical friends wished us to select the constant speed squirrel cage motor, run the booster at full speed, and regulate the pressure by churning around the excess gas through a bypass. This would have meant a 50% reduction in life of our wearing parts, and would have caused excessive heating of the booster casing. The chief point they brought up was the decreased danger of sparking, which they stated would occur at the controller and collector rings of the variable speed motor. Our experience, however, has shown us that sparks may be expected from any motor at some time, from loose connections, break downs of insulations, or foreign material getting in between rotor and starter, and if explosive mixtures are around one spark is enough. It does not require a dozen. The whole question of safety then came to this: That if we employ electricity we must keep our room well ventilated and minimize leakage of gas.

The projected capacity of the Ville La Salle gas works is ten million cubic feet per day, and the present capacity four million. The expectation is that all our gas will go out under high pressure and that this station will primarily handle peak loads. To accomplish the distribution of this gas we laid out our booster room to take five units, two of 500,000 cubic feet per hour capacity against 6 pounds pressure, and three of 200,000 cubic per hour capacity. For the present we have installed one large and one small unit.

The machines are described as single geared horizontal high pressure gas exhausters. The 500,000 cubic foot unit has a displacement of 55.6 cubic feet per revolution, and a maximum speed of 175 revolutions per minute. It is driven through a cut steel herringbone gear reduction, by a 270-horse power induction motor of 600 r.p.m. The actual tested slip on this exhauster was 28 revolutions per minute on coal gas. The 200,000 cubic foot unit has a displacement per revolution of 16.45 cubic feet, and a maximum speed of 250 revolutions per minute. It is driven through a similar gear reduction by a 110-horse power induction motor. The tested slip on this exhauster was 46 r.p.m. The motors are supplied with enough variable resistance in the rotor circuit to give a 50% speed reduction at a pressure of 1¾ pounds. The speed depends to a great extent on the load being lower at a given notch of the controller for high pressures than lower pressures. Thus while the motor will run at full speed on the last notch at any load, it will also run at full speed on the first or any other notch when the gas is by-passed, i. e., at no load. As the pressure increases the speed falls, and as the pressure drops the motor speeds up. The characteristic makes it very flexible in operation, since it tends in some degree to automatically maintain uniform pressure, and while the alternation in speed is naturally not enough to bring the pressure back to its former point, it is, nevertheless, sufficent to warn the attendent of altered conditions, so that he can regulate speed at once.

An interesting feature about the electric supply is that it is brought to the motor at a potential of 2,200 volts, thus doing away with the necessity for a large transformer installation with its added maintenance and opportunities for trouble. We may say that the operation of the plant with this high voltage has been perfectly satisfactory, the only noticeable difference in handling the current being the necessity for oil switches with overload release on our main supply, and for each machine. We found a certain amount of flashing at the controller speed of motor, so considered it advisable to use an oil tank in which the controller is submerged, and now sparking is practically absent.

The gas is brought to the booster by a 36″ main from the gasholder, and connections on suction side are cast iron, 24″ to the large unit, a 16″ to the small unit, and similar provision for future installation of additional machines.

The basement containing these pipes is about 7 feet deep from operating floor of steel bar grille work. Thus ample headroom is afforded in basement for inspection and care of under floor pipes, valves, etc., and ample light and ventilation are possible through construction of floor, since no dead spaces are afforded in which gas could collect. The room above the floor is provided with two tiers of windows on four sides, with pivoted ventilation in sash. There is also a monitor in roof with mechanically operated ventilating sash in sides.

The boosters discharge into a 30″ riveted steel overhead pipe, that drops through the floor at the north end of the building and connects with the 30″ cast iron main under ground.

A most important point in the installation of high pressure exhausters is the necessity of a non-return or check valve in either the suction or discharge pipe of each machine, preferably the latter. The writer wishes to lay stress upon this point, because it has not to his knowledge been brought out in the technical press, and the makers of the boosters had not considered the check valve necessary; the reason for this is probably that the vast majority of these plants are steam driven. When the engineer shuts the booster down he finds by experience it is necessary to leave a little steam on his engine until he shuts the valve on his booster, otherwise the gas pressure in the discharge will run the machine backwards. This is especially the case when two or more machines discharge into the same header or main. With the electrically driven machine, however, it is necessary to shut off the current before closing the valves, as otherwise electrical damage may result. When the machine is not equipped with a check valve, reversal takes place with inconceivable rapidity after the current is cut off, and a destructive speed is attained in a few seconds. After one experience of this kind we operated our machines with one man at the controller and two men to close suction valve in case of interruption of current, until such time as we had check valves installed. With the check valves, an interruption of the electric supply simply causes the machines to stop.

The writer recollects similar experiences with an installation of three positive blowers driven by Corliss engines supplying blast through a common header to a large water gas plant. In this case if one engine attained a greater speed than another, the slowest one was gradually forced to stop and then made to run backwards. In this case the danger is not so immediate, since the backward speed attained is not destructive, but it necessitates constant attention of the engineer, and on one occasion the occurance resulted in a serious explosion, wrecking one blower. The contributary cause in this instance was a leaky blast valve on a generator, a not uncommon occurance, allowing gas to find its way back to the blower, forming an explosive mixture, which ignited as soon as the water gas machine started to blast again.

Another instance since brought to the writer's attention, is a capacity rotary water pump, built on the same principle as the gas exhauster. In this case the unit was steam driven, and a valve being opened by mistake, the machine ran backward, bursting the flywheel, which was 25 feet in diameter, having attained a destructive speed before the engineer could bring it under control.

To regulate the pressure at which the gas is delivered we have ten notches on each controller. It will be evident that this alone is not a perfectly flexible means of regulation, since there will be many cases where one notch would give too much pressure, while the next lower notch would not give enough. This is taken care of by a 12″ by-pass from the discharge to the suction side, so that if more pressure is desired and the next notch gives too much, the by-pass is opened slightly, allowing the excess gas to pass into the suction. The amount of gas by-passed is never great, and two turns on the 12″ valve is usually enough to regulate the pressure to any desired point.

The attention required to maintain uniform pressure is necessarily greater with the electric driven than with steam drive, as explained above. This, however, is not an unqualified disadvantage.

We have found the whole plant very flexible and satisfactory in operation. The stoppages due to interruption of electric service have been very few, due to the number of sources from which the company's power can be obtained.

Woodrow Wilson's Rules of the Game.

"First of all is the rule of publicity, not doing anything under cover, letting the public know what you are doing and judge of it as it is. A great many businesses have fallen under suspicion because they were so secretive, when there was nothing dishonorable to conceal. The second is a full equivalent for money you receive—the full equivalent in service—not trying to skimp in the service in order to increase profits above a reasonable return, but trying to make the profits proportioned to the satisfaction of the people you serve."

Making Converts.

By JACOB B. JONES.

We do not have the advantage of a Window Display at Bridgeton, as the office is conveniently located at our works but it is not on the main street. We carry a full line of gas appliances, fixtures, lamps, etc., and for several years past have encouraged telephone orders, and have delivered advertising cards for our monthly prepayment statement. The May and October cards reads as follows:

M A Y, 1 9 1 5

Prepayment Meter Record

The Statement of your meter on this date is.....

The actual amount of money removed on this date is $.....

The Inspector will teach you "How to Read Your Meter"

WHY LABOR AND FRET OVER YOUR IRONING?

The IWANTU Gas Iron may be connected to a gas fixture in a few seconds. You light the gas and begin to iron. The iron stays hot. But it does not heat the room. You need not leave the board—time is saved and comfort gained. When through ironing turn out the gas, and all expense stops.

The Bridgeton Gas Light Company

(Over)

O C T O B E R, 1 9 1 5

Prepayment Meter Record

The Statement of your meter on this date is.....

The actual amount of money removed on this date is $.....

The Inspector will teach you "How to Read Your Meter"

Drive Away the Chill with a..... ***GAS HEATER*** You will be surprised at the great service you get for the small amount of gas it uses. You are invited to call at our office and see the variety of GAS HEATERS. The prices are very reasonable.

The Bridgeton Gas Light Company

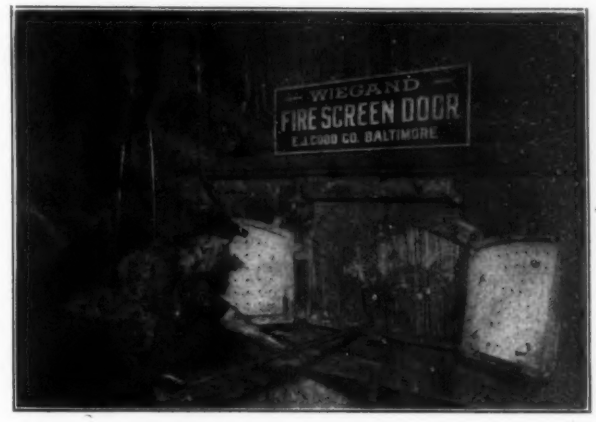
(Over)

By these means we have secured much new business, which has been supplemented by personal work, and in many instances showing the consumers different types of appliances in their own homes rather than on our floor. When the subject of gas lighting week came up we arranged for a widow display on our principal street, with the result as you see it. Personally, I feel that it was a big help to us, so much so in fact, that we are considering if not a permanent arrangement, at least a frequent display of seasonable appliances and fixtures.

"This Window was hired for Lighting Week."

New Methods and Appliances.

CHAIN SCREEN FOR FIRE DOORS.—To protect firemen when the door of a boiler furnace is open, and at the same time prevent cold air from entering the furnace, this auxiliary chain door has been developed. The Wiegand chain door, as it is called, consists of a number of freely hanging strands of small steel chain suspended from a cylinder supported above the furnace opening. The chain screen is rolled up when the fire door is closed, and is automatically unrolled when the fire door is opened. The air that enters the fire box while the door is open must pass through the chains, which breaks it up into numerous small pencils and cause it to mix thoroughly with the gases from the fire bed, thus promoting instead of hindering, combustion. The chain screen doors is also adapted for use with ovens and metal and chemical furnaces.



Chain Screen for Furnace Openings.

GAS PURIFICATION WITH CARBONATE OF POTASH.—A method for washing sulphuretted hydrogen and hydrocyanic acid out of coal gas by means of a solution of carbonate of potash is described in "Het Gas." The reaction is very active, a 25% solution of carbonate removing H_2S up to 1.2% in the gas. While dry purification leaves 60 grammes of sulphur per cubic metre of gas, the potash leaves only 35, and removes all the hydrocyanic acid, instead of but 60 to 70%. When air is forced through the product the sulphuretted hydrogen and hydrocyanic acid are liberated, and the liquid is regenerated. The air drives carbonic acid out of the bicarbonate present, forming carbonate, and the carbonic acid set free decomposes the sulphide and cyanide, again forming carbonate. The required bicarbonate of potash is formed during purification, by absorption of carbonic acid from the coal gas. Without bicarbonate there is no regenerative effect. Too much carbonic acid in the gas hinders the absorption of sulphuretted hydrogen and carbonic acid; but the carbonate cannot be wholly converted into bicarbonate. When driven through a solution containing 2.1 pounds of $KHCO_3$ per gallon, the air is found to contain 5.2% of CO_2, which has been lost by the bicarbonate; and a condition of equilibrium is reached, between carbonate and bicarbonate, in which no more carbonic acid is lost. Temperature has, however, a great influence in promoting this dissociation of the bicarbonate. If H_2S is present, another equilibrium is reached, the carbonate of potash becomes partly converted into sulphide. During regeneration both CO_2 and H_2S are removed. When gas is washed in a solution of bicarbonate of potash, the gas drives out some carbonic acid, and the carbonate of potash left absorbs H_2S. The larger the proportion of bicarbonate remaining in the solution, the more rapid the regeneration; therefore the air used should contain some carbonic acid. Too much carbonic acid in the air leaves too little carbonate in the solution, and, therefore, its absorbent power for H_2S and HCN is lessened. The best results are obtained when the air contains from 2 to 3% of CO_2; and this can be had by using chimney gases (washed in 10% solution of carbonate of soda) diluted with air. The temperature of regeneration is 104° to 122° F.

IF a lump of ice is placed on a plate and light allowed to fall on it through an ordinary reading glass, so that the burning focus comes within the lump, a very interesting thing may be seen. The ice will begin to melt inside at the point of focus, the space is almost a vacuum and filled with water vapor under very small pressure.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT the meeting of the directors of the Municipal Gas Company of Albany, N. Y., the contract for the erection of the new building of the company, at 126 State street, was awarded. The building will be 6 stories high and will cost approximately $275,000.

DURING the month of September the Union Light, Heat and Power Company, Fargo, N. D., gained 54 gas customers and 94 electric customors. This compares with a gain of 52 gas customers and 54 electric customers in September, 1914.

ALL books and papers relative to the operation of the Bessemer (Ala.) Gas Company have been turned over to the Birmingham Railway, Light and Power Company. The sale was arranged and practically consummated in August, but was held up on account of a few technical delays. The gas company, as a whole, has been transferred to the railway company. L. W. Allen, local manager of the B. R. L. & P. Company, has charge of the addition department. W. W. Baltar, Jr., former general manager of the gas company, will remain in Birmingham until Mr. Allen is thoroughly familiar with the operations. It has not yet been definately settled as to whether or not the offices of the gas company will remain where they are, or the offices of the railway company and the gas company consolidated.

THE "Cincinnati Commercial Tribune" says: "The Stacey Manufacturing Company assists in lighting the world. It does not manufacture candles, nor yet electrical machinery, but it does manufacture and ship complete gas plants all over the world. It has specialized for some time in designing and constructing gas holders, from the small-town size to the largest size ever manufactured, and has a large plate and structural metal department."

ROBERT W. KIPLE, assistant manager and purchasing agent of the Pennsylvania Utilities Company, Easton, Pa., has resigned that position to become commercial manager of the United Gas and Engineering Corporation at Harrisburg, Pa., the change becoming effective November 1.

WAYCROSS, GA., has received another gas proposition. Application for a franchise was filed several weeks ago, and a special committee appointed by the Mayor to investigate. The committee so far has been satisfied of the good intentions of the petitioners, who offer to deposit a thousand dollars with the city as evidence of good faith. They agree to have the plant in operation within a year after the franchise is granted, and say they are ready to begin work the day the franchise is given them.

THE New York papers say, that 22,000,000 cubic feet of gas a day is being sent through the 72" cast iron main in the new Astoria gas tunnel.

THE Mayor of Flint, Mich., wants that city to appoint gas and meter inspectors. His message to the Council says: "Another vital proposition is the quality of gas and the correctness of both the gas and electric meters. To take care of this I suggest that an ordinance be adopted similar to the one in force in Detroit. In that city each fire station is equipped with a recording gauge, and each day these readings are turned over to the gas meter inspector of that district, who also takes a quantity of gas from the different testing stations and makes tests in his laboratory of the heat and light units contained therein. He also takes into consideration the pressure at these various stations, and is thereby enabled to ascertain whether the consumers are being furnished with the proper grade and quantity of gas. He also has the authority, and it is his duty, to inspect and test all the gas and electric meters at frequent intervals to see that they are correct, and if not, to have proper adjustments made."

THE Indiana Coal, Coke and Gas Company will compete for the street lighting of Terre Haute, when the present contract of the city with the Electric company expires. The plan of the gas company, it is understood, is to install a boulevard lighting system such as in Indianapolis.

MR. M. W. STROUD, President, and I. S. Lowry, Vice-President, of the American Gas Company, and members of the board of directors of the company, are making their annual tour of inspection of their plants.

THE St. Clair County Gas and Electric Company has appealed from the decision of the Illinois Utilities Commission which ordered a reduction of the gas rate from $1.25 to $1 per 1,000 cubic feet in Belleville. In its appeal the company alleges that the rate is too low, und is virtually a confiscation of its property. This rate cut is the first one ordered by the Illinois Commission, and Belleville people seem to believe that the public utility companies of the State have combined to fight the order.

AT a meeting of the City Trustees of Huntington Beach, Cal., the city attorney was instructed to draw an ordinance calling for an election to allow the citizens an opportunity to approve or disapprove an issue of bonds for the purpose of installing a municipal gas plant or taking over the present system. Some time ago the city engineer was requested to prepare an estimate of the approximate cost of installing a gas plant, and from his report the cost of duplicating the present system would be about $15,000. The city of Huntington Beach is at present supplied with gas by the West Coast Gas Company.

THE Gulf Coast Gas Company, Biloxi, Miss., has nearly completed improvements to the value of $58,000, consisting of a new coal gas installation. These improvements follow the damage that the company suffered from the September storm, amounting to $15,000.

THE Springfield Gas Light Company has offered to give Chicopee, Mass., the same gas rate as Springfield, beginning July 1, 1916. If the board accepts the rate proposed by the company the hearing before the State Gas and Electric Light Commission will be cancelled.

THE New York "Editor and Publisher" says: "The Consolidated Gas Company this week published the largest advertisement ever used by a gas company in this city. It measured four columns wide and thirteen inches deep—782 lines. The ad., which was strikingly attractive in design, introduced the new 'CE-Z' gas lamp, and was designed, illustrated and written by Robert E. Livingston, the advertising manager of the company. The illustration, which occupies the right side of the ad., shows Bartholdi's statue of 'Liberty Enlightening the World,' the new lamp taking the place of the torch in the hand of the Goddess' uplifted arm."

THE Lawrence (Mass.) Gas Company Employees Association celebrated the opening of their monthly meetings, Nov. 3d, when the first meeting was held in Eagles Hall. Nearly 150 members attended, and later enjoyed the "smoke talk" and entertainment. Daniel J. DeCourcy, president of the association, opened the meeting and presided at the business session, which was a very brief one. Similar sessions, he said, would be held once a month in the future. An entertainment followed, including three enjoyable reels of motion pictures, songs by William Riley, Joseph Joubert, Thomas Morrissey and George Ubert; dances by James McGrady and Eugene Murphy, and piano selections by James McNulty and George O'Brien. Smoking materials were distributed early in the evining, and the entertainment was presented in a haze of friendly smoke from the most democratic of all friendly pipes.

THE Consumers Gas Company of Toronto, in its annual report, states that there are 6,500 vacant houses in that city; that in the year ended Sept. 30, the company sold $29,496 less gas, and that the deficit on the year's business was $218.

IN the matter of the application of the Bangor (Me.) Gas Light Company to grant its service at reduced rates for a charitable and benevolent purpose, the State Public Utilities Commission orders: "That this commission approve the granting to the Good Samaritan Home of Bangor, Maine, of service by the petitioner at the rate of $1 per year, said rate being less than its regular rates."

THE Old Colony Gas Company, Braintree, Mass., has started a schedule that allows the entire office force 15 minutes each morning and afternoon for games with the medicine ball.

THE Wrenham, Mass., board of selectmen have voted a franchise to the Wrenham Gas Company, petitioned for by the directors,

Clarence A. Barnes, Charles A. Day and Edward F. Draper, directors of the Franklin Gas Company, which petitioned the Franklin board of selectmen for a franchise, a hearing upon which is still under consideration by the selectmen. The company has also been granted a franchise at Needham, and has petitioned the Foxboro board of selectmen for a franchise in that town.

THE service now being supplied to the towns north of Hartford, Conn., by the Hartford Gas Company is soon to be transferred to the Springfield Gas Light Company, and the Northern Connecticut Light and Power Company, which controls the gas output in these towns, will secure their gas from Springfield on or about December 15. For some time negotiations have been pending, and the Springfield company has built a pipe line through the towns of West Springfield and Agawam; and near the Connecticut line at Longmeadow, the pipes were laid across the Connecticut River to the Connecticut company connection at State line, and thence continued through Enfield street to Freshwater Pond, where the main line of the Light and Power Company is located.

CAPITALISTS from Southern California are gathering data as to the growth and future prospects of Orland, looking to the establishment of a gas works there. It is said the town is capable of supporting such an enterprise, and the steady growth along all lines promises well for the future of the investment.

THE executive committee of the Public Service Gas and Electric Companies has completed its annual inspection of the physical property of the companies throughout New Jersey. During the inspection the committee traveling in motor cars, covering 735 miles Asked to comment on the inspection, President Thomas N. McCarter declared the committee had found the gas and electric properties in excellent condition. The yearly inspections of the physical property of the companies is made for the purpose of acquainting the officials with the actual condition of the various holdings. The information is utilized when the annual budget is made up after the close of the fiscal year on January 1.

REASONS why Los Angeles, Cal., should get a supply of straight natural gas, instead of a mixture of artificial and natural gas, such as is served by two of the companies there, were given to the City Club by L. P. Lowe, president of the Economic Gas Company, in a recent address. Mr. Lowe spoke on the topic, "Can Los Angeles get Natural Gas?" His answer was decidedly in the affimative. He claimed there was no reason, except profit, for the serving of artificial gas in Los Angeles at the present time.

IN an article in the November number of McClure's, headed "Keeping Money at Home," Albert W. Atwood, the financial editor of the publication, says, "Finally I want to urge readers of this article who have money to invest, to look around and see whether any of the great, fundamental public utility enterprises of their own section are offering stock to their customers."

AT a recent Rotary Club luncheon at the Bossert, Brooklyn, N. Y., T. M. Ambler, manager of the commercial department of the Brooklyn Union Gas Company, was the speaker. C. J. Edwards, president of the club, in presenting Mr. Ambler, gave a humorous sketch on the dangers of gas lighting. When it was first introduced into Germany eighty-nine years ago it was opposed on theological grounds: the thwarting of Providence, which had appointed darkness for the hours of night; on moral grounds: drunkards would feel no hurry to go home, and late sweethearting would be encouraged; on police grounds: it would make the horses shy; and on patriotic grounds: that national illuminations would lose their stimulating effect if there were a quasi-illumination every night of the year. Mr. Ambler, after good-naturedly admitting the many evils he had in part encouraged, told what was being done with gas apart from that employed for illumination. He spoke of its increased use for cooking and heating, and of the large attendance of women at the lectures of the company in Livingston street. With the advent of electric light, about 35 years ago, a slump in gas stocks was predicted, but from that competition sprung initiative with the gas mantle and other devices of to-day as the result. At the present time 13,000,000,000 cubic feet of gas yearly are consumed in Brooklyn.

UTILITIES COMMISSION NEWS.

REFUSES TO ADOPT A FIXED RATE OF RETURN.—The Idaho Utilities Commission which recently handed down a decision in the case of the city of Sandpoint against the Water Company, in speaking of the rate of return, said:

"This Commission will not be placed in a position of stifling ambition and effort in the development of public utility enterprises by adopting a fixed percentum as the rate of return which a utility shall be allowed on its investment. The rate of return will be determined in each individual case, giving due consideration to efficiency and economy in management, and thus afford a stimulus for the utility to increase its business, to reduce its operating expenses and thereby reduce the cost of the commodity to the consumer. If a public utility can by efficient management reduce the operating expenses below the ordinary amount, or if it can by the application of a broad and public spirited policy, develop a community and thereby develop its business and increase its earnings, it is certainly entitled to share in the increased earnings directly resulting therefrom. The Commission finds that 8% per annum is a reasonable rate of return on the investment now under consideration."

ILLINOIS COMMISSION DEPRECIATION.—An indication of how the Illinois State Public Utilities Commission will compute depreciation of property in cases where that question comes up, was given in a decision handed down in the case of the complaint of the city of Belleville, Ills., against the St. Clair County Gas & Electric Company. The Commission adopted the "straight-line" method of determining depreciation instead of the "sinking-fund" method of the company. While the complaint was against both gas and electric, the ruling is only in regard to gas, and the price for gas to Belleville is cut from $1.15 net to $1 net per 1,000 cubic feet. The Commission fixes the value of the Belleville property at $265,000, considerably less than the value fixed by the company. It allows a return of 7¼% on investment and 3% for depreciation.

The text of the Commission's ruling on the method of determining depreciation is as follows:

"The two principal methods of determining depreciation have been introduced in the hearings of this case. The respondent has submitted a valuation in which the present worth of the property is deduced by the sinking-fund method of reckoning depreciation, whereas the Commission's engineering staff has submitted a valuation in which present worth is deduced by a simple straight-line method. Neither method needs elaborate explanation and amplification at this time. It is sufficient to note that the sinking-fund method provides for a slower depreciation in value during the early years of the life of the equipment than is provided by the straight-line method. The sum to be set aside annually to cover the sinking-fund depreciation, however, is a relatively smaller operating charge than the sum required by the straight-line method. Thus in computing a fair rate schedule the interest on a higher capitalization which may be found by using sinking-fund methods is offset to a certain extent by the lower annual depreciation charges on operating accounts. It is to be noted, moreover, that the straight-line method seems to be the best average of all the theoretical methods of computing depreciation."

NOT RESPONSIBLE FOR GAS RANGE EXPLOSION.—In instructing the jury to return a verdict for the Consolidated Gas, Electric Light and Power Company in the suit for $25,000 damages brought by Mrs. Alice B. Pearson, of Baltimore, Md., the Superior Court decided that the company was not responsible for an explosion in a gas that range had been installed. The Court ruled that the range then was beyond the control of the company, and held that the company had been guilty of no negligence. The case is the first of its kind to be determined in Maryland, and, according to counsel in the case, has no precedent in the United States.

Mrs. Pearson was burned when an explosion occurred as she opened a gas stove in her home on October 31, 1914. The gas flared out, singed her hair and burned her face. She claimed she had lost the sight of her right eye and that her face was disfigured for life. August W. Schnepfe, her counsel, held that the company was responsible for the explosion because it had increased the pressure of gas in the pipes.

Judge Soper ruled that not sufficient evidence was introduced to sustain their contentions nor to warrant the case being given to the jury for determination.

Financial Notes.

IN the matter of the WATERBURY (Conn.) GAS LIGHT COMPANY against the collector of internal revenues, Judge Edwin S. Thomas has filed an opinion in the United States Court sustaining the plaintiff's demurrer to the defendant's answer, and directing a decree accordingly. The action was brought to recover taxes assessed by the department of internal revenue against the plaintiff company for the years 1910, 1911 and 1912, under an act of Congress passed August 5, 1909. The Waterbury Gas Light Company is a Connecticut corporation, chartered for the purpose of manufacturing, selling and distributing gas. On March 30, 1894, the company leased all of its premises and property to the United Gas Improvement Company for 20 years, in consideration of an annual rental. Certain taxes were assessed against the Waterbury Gas Light Company, which the company paid under protest. The suit was for a refund of the money so paid, on the ground that the Waterbury Gas Light Co., at the time the taxes were levied and paid, was not "engaged in business" within the meaning of the Federal corporation tax acts. The answer of the collector set up, as he alleged, the legal sufficiencies for the collection of taxes by the internal revenue department for the years outlined. The demurrer attacked these alleged "sufficiencies," and in sustaining the demurrer, the case of the Waterbury Gas Company to a right of refund of the taxes paid, is sustained.

INCOME report of the LACLEDE GAS LIGHT COMPANY, of St. Louis, for the 9 months ended September 30, shows a decline of $17,600 in gross earnings, which amounted to $3,370,901, compared with the same period a year ago. Net earnings, however, made an advance of $145,665, to $1,848,356. The company expended for interest charges, etc., and for dividends on the preferred stock a total of $1,187,786, leaving a surplus balance of $660,570, against $563,905 in 1914.

BROOKLYN BOROUGH (N. Y.) GAS COMPANY directors are said to be considering an increase in the dividend rate.

THE following comparison of earnings of the FALL RIVER (Mass.) GAS WORKS CO., in October of this and last year has been published:

	1915.	1914.	Inc.
Gross	$48,321	$45,626	$2,695
Net	18,289	14,465	3,822
Balance after charges	18,286	11,619	6,667

APPLICATION has been filed with the Public Service Commission by the ST. LOUIS COUNTY GAS COMPANY for authority to increase its capital stock from $1,000,000 to $1,400,000 and to issue bonds to the amount of $170,000. The bond issue and $200,000 of the stock increase to be issued at once will take up floating indebtedness of the company contracted in making extensions of the plant that have been completed.

RETIRING directors and officers were re-elected at the annual meeting of CONSUMERS GAS COMPANY of Toronto, Can. The financial statement for the fiscal year ended September 30, 1915, showed an increase in meters of 2,900, to 102,584, with gas sales of $2,423,921, a decrease of $29,496, or 1.2% from the preceding year. During the year the company laid fifteen miles of new street mains and installed 3,124 new services. In regard to the year just ended the directors say: "Operating costs have increased, items of additional expenditure, generally of an uncontrollable nature, being, either directly or indirectly, principally war taxes. The imports of raw materials used by the company have been made subject to a special tariff over and above the normal customs' charges, and there has been an increase of nearly 29% in municipal taxes. The policy of strict economy inaugurated by the board has resulted in the revenues of the year being sufficient to cover operating expenses, actual cost of repairs and renewals, interest charges and dividends."

THE net earnings of the subsidiary companies of the UNITED GAS IMPROVEMENT COMPANY for three-quarters of the year 1915 are considerably ahead of the corresponding period in 1914, owing largely to the lower cost of oil used in the manufacture of gas. The output of gas outside of Philadelphia increased 3.1% in the nine months and 5.5% in the month of September. In Philadelphia a similar tendency is in evidence, that is a higher rate of consumption in recent months than prevailed in the early part of the year. While there was a decrease of 0.95 of 1% in this city in gas sales for the nine months ended September 30, 1915, as compared with 1914, there was an increase of 2.05% for the month of September.

IT is estimated that for 1915 the AMERICAN GAS AND ELECTRIC COMPANY will earn close to 25% on the common stock. Surplus for year ended Aug. 31 equalled 22.5% on this issue.

PACIFIC GAS AND ELECTRIC COMPANY has declared the regular quarterly dividends of $1.50 a share on its first preferred and its original preferred stock, both payable Nov. 15, to stock of record, Oct. 30.

MASSACHUSETTS GAS COMPANY declared usual semi-annual dividend of 2% on preferred shares, payable Dec. 1. Transfer books close Nov. 15, and reopen Dec. 1.

DIRECTORS of the LINDSAY LIGHT COMPANY have increased the dividend on the common stock from ½ to 1% for the quarter, thus raising the rate from 2 to 4% annually. The usual dividend of 1¾% was declared on the preferred stock. Both disbursements are payable November 30 to stockholders of record November 15. The company sold in October 925,000 gas mantles, a net gain of 34% compared with the corresponding month last year.

CONTENTS.

AN ASTERISK (*) DENOTES AN ILLUSTRATED ARTICLE.

*THE PRESENT PRACTICE OF GAS DISTRIBUTION BY BRITISH UNDERTAKINGS, by Walter Hole 305
A NEW ALUMINUM ALLOY 309
*THE HEAT TREATMENT OF IRON AND STEEL IN A NEUTRAL ATMOSPHERE, by Alfred H. White and Homer T. Hood. 310
EDITORIALS 312
Evil Influence of Public Ownership—Public Utilities Section of the National Safety Council—Illuminating Engineering Society—American Electrochemical Society.
OFFICIAL NOTICE—
New Jersey State Gas Association 312
ELEVENTH ANNUAL CONVENTION AND GAS APPLIANCE EXHIBIT, NATIONAL COMMERCIAL GAS ASSOCIATION, WASHINGTON, D. C., NOV. 29 TO DEC. 4, 1915 313
GAS ANALYSIS BY LOW TEMPERATURE FRACTURIZATION 315
A MOTOR-DRIVEN HIGH-PRESSURE GAS PUMPING INSTALLATION, by J. S. Haug 315
WOODROW WILSON'S RULES OF THE GAME 316
*MAKING CONVERTS, by Jacob B. Jones 317
NEW METHODS AND APPLIANCES 317
*Chain Screen for Fire Doors—Gas Purification with Carbonate of Potash.
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 318
Albany's New Building—Gains in Fargo—Bessemer Company Transferred—Stacey Lighting the World—Mr. Kiple Changes—Waycross Bargaining Again—The Big Pipe in Use—Flint, Mich., Wants Inspection—Gas Lights for Terre Haute—Mr. Stroud Inspects—Belleville Rate Too Low—Huntington Beach to Vote—Biloxi Building—Chicopee to Get Springfield Rate—Biggest New York Gas Ad.—Lawrence, Mass., Employees Assn.—Vacant Houses Hurt—A Special Rate—Time to Play—Wrenham, Mass., Franchise—Source Shifted—Orland, Cal., for Gas—Public Service Inspection—Straight or Mixed—Keeping Money at Home—Mr. Ambler to Rotarians.
UTILITIES COMMISSION NEWS 319
Refuses to Adopt a Fixed Rate of Return—Illinois Commission Depreciation—Not Responsible for Gas Range Explosion.
Financial Notes 320
Public Lighting Table for Nov., 1915 (Ad. Section) 7
Meeting Times of the Various Gas Associations (Advertising Section) 21